The Sjovold Site

A River Crossing Campsite in the Northern Plains

Ian Dyck and Richard E. Morlan

with contributions by
E.A. Christiansen, Hugh E. Hendry, D.W. Anderson and J.G. Ellis

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Abstract

Excavations on the west bank of the South Saskatchewan River in south-central Saskatchewan have revealed the remains of a stratified bison hunters' campsite with more than twenty separate episodes of occupation. The remains were buried in a depositional sequence, 4.2 metres deep, near the mouth of "Sjovold Creek" (informal name). The earliest occupation is dated to about 1850 B.C., and subsequent uses of the site occurred at intervals of roughly 165 years until about A.D. 1350. Archaeological complexes include Hanna, Pelican Lake, Besant, Samantha/Avonlea, Avonlea, and Moose Jaw. Although the site seems to have had little use between A.D. 1350 and 1850, it does appear to have been known during early historic times. The last occupation by bison hunters may have occurred during the middle decades of the 1800s. Studies of environmental, historical, archaeological, and geological context show that the site is situated on the west edge of the second prairie step; that it is on the boundary between Great Plains grasslands and northern parklands; that it lay within a buffer zone shared by several bison-hunting Indian nations during early historic times; that it contains samples from some of the most poorly known regional archaeological complexes; and that it has been used for as long as its surface has been habitable.

The body of this report is devoted to detailed descriptions and interpretations of archaeological remains from each occupation layer — altogether some 77 archaeological features; 11,454 pieces of coarse rock (granite being the most heavily utilized); 1,451 potsherds (including Wascana ware and Avonlea types); 201 stone tools (the most common being marginally utilized or retouched lithics [MURLs], projectile points, and endscrapers); 6,570 pieces of chipped stone debris (exhibiting a mixture of local and exotic types and representing all phases of reduction); 70 chipped stone cores (mainly of the bipolar type); 39 bone tools (predominantly pressure flakers, awls, and choppers); and more than 25,000 pieces of animal bone. Hearths and associated rock clusters are the predominant feature types, but excellent examples of hide-smoking pits, a pottery-firing hearth, a shield-making pit, sweat-lodge rocks, sleeping areas, and a roasting trough are present. All of these remains are consistent with brief campsite occupations by people whose primary subsistence activity was bison hunting. Nevertheless, there is evidence of a wide variety of other animal resources: canids (including dogs), deer, wapiti, pronghorn, moose, grizzly bear, lynx, beaver, muskrat, badger, rabbit or hare, fisher, birds such as the raven and eagle, large and medium-size birds' eggs, and freshwater clams.

The first five chapters of the book present the physical and historical setting of the Sjovold site, previous regional and local archaeological work, the natural and cultural stratigraphy and chronology of the site, and an overview of its contents. Chapters 6 through 25 describe and interpret each of the twenty main occupation layers. In most cases a detailed planview provides a snapshot of the arrangement of features and artifacts, whose functions are interpreted in the light of extensive historical and ethnographic literature. The faunal remains are considered with regard to multiple taphonomic histories in order to identify those that are related to human activities and those that owe their origins to other causes. Each of these chapters concludes with a synthesis of the descriptive and distributional data to forge an interpretation that probes the sociocultural and historical contexts of the occupation. For example, it appears that group composition and size varied from one occupation to another. Some layers provide evidence for mixed age and gender as might be expected in extended families and microbands; others, for more specialized task groups as in outdoor work areas

used primarily by women. Yet others reveal hunting- or war-party campfires used primarily by men. The majority of occupations for which seasonality can be determined occurred during fair weather. The final chapter is a retrospective overview that highlights the main contributions of the Sjovold site excavation and analysis, as well as changes through time in both cultural systems and environmental conditions.

The site's existence is probably due to its proximity to one of the few good river crossings in the region. The South Saskatchewan River, about 600 metres wide through much of its course, is deeply incised into soft glacial tills and underlying late Tertiary deposits. Before the installation of ferries and bridges, most fair-weather crossings required rafts or other small watercraft. Strong undertow currents and areas of quicksand deterred all but the most daring swimmers and pedestrians. Even watercraft-assisted crossings, however, had some special requirements: shallow approach grades with good footing on both sides of the river, a river channel free of braided sand bars, wood for watercraft construction, and campsites on both sides in which to live during the construction of watercraft and while goods and people were being ferried. The Sjovold locality possesses all these characteristics, and the Sjovold site is the first Northern Plains river crossing campsite to receive definition and study.

Résumé

Les fouilles de la rive ouest de la rivière Saskatchewan Sud, au centre sud de la Saskatchewan, ont mis au jour les vestiges d'un terrain de campement stratifié de chasseurs de bisons, qui montrent plus de vingt périodes d'occupation. Les vestiges ont été déposés séquentiellement, à 4,2 m de profondeur, près de ce que l'on a surnommé le ruisseau Sjovold. La période d'occupation la plus lointaine remonte à environ 1850 av. J.-C., et le site a ensuite été utilisé à des intervalles de 165 ans jusqu'à 1350 ap. J.-C. L'ensemble du complexe archéologique comprend Hanna, le lac Pelican, Besant, Samantha/Avonlea, Avonlea et Moose Jaw. Quoiqu'il semble que le site ait peu été utilisé entre 1350 et 1850, tout porte à croire qu'on en connaissait l'existence au début de la période historique. Les chasseurs de bisons semblent avoir cessé de l'occuper vers le milieu des années 1800. Des études des contextes environnemental, historique, archéologique et géologique démontrent que le site est situé à l'extrémité ouest du deuxième palier de prairie; qu'il est à la frontière entre les prairies des Grandes Plaines et les forêts-parcs du nord; qu'il s'étend à l'intérieur d'une zone tampon partagée entre plusieurs nations amérindiennes de chasseurs de bisons au début de la période historique; qu'il renferme des échantillons de certains des complexes archéologiques régionaux les moins connus; enfin, qu'il a été utilisé depuis aussi longtemps que sa surface a pu être habitée.

La majeure partie de ce rapport donne des descriptions détaillées et des interprétations des vestiges archéologiques trouvés dans chaque couche d'occupation, en tout 77 éléments archéologiques; 11 454 fragments de pierre grossière, surtout du granite, qui était le plus utilisé; 1 451 tessons dont certains typiques d'Avonlea et de la céramique de Wascana; 201 outils en pierre dont les plus communs ont très peu été utilisés ou sont des éclats retouchés, des pointes de projectiles et des racloirs; 6 570 débris de pierre taillée, qui montrent un mélange de pierres de source locale et exotique et représentent toutes les phases de réduction; 70 nucleus, principalement de type bipolaire; 39 outils en os, surtout des outils à tailler par pression, des alènes et des hachoirs; et plus de 25 000 fragments d'ossements animaux. Des âtres et leurs amoncellements de pierres caractéristiques sont prédominants, mais on a aussi trouvé d'excellents exemplaires de fosses pour le fumage des peaux, un foyer pour la cuisson de la poterie, une fosse pour la fabrication de boucliers, des pierres à suerie, des aires de couchage et une fosse de grillage. Tous ces vestiges permettent de croire que des gens dont le principal moyen de subsistance était la chasse au bison ont occupé brièvement le terrain de campement à plusieurs reprises. On a pourtant trouvé l'évidence qu'une grande variété d'autres ressources animales : canidés (y compris des chiens), cerfs, wapitis, antilopes, orignaux, grizzlis, loups-cerviers, castors, rats musqués, blaireaux, lapins ou lièvres, pékans, oiseaux (corbeaux et aigles), œufs d'oiseaux (gros et moyens) et palourdes d'eau douce.

Les cinq premiers chapitres du volume décrivent l'aspect physique et le cadre historique du site Sjovold, les recherches archéologiques régionales et locales antérieures, la chronologie et la stratigraphie naturelles et culturelles du site ainsi qu'une vue d'ensemble de son contenu. Les chapitres 6 à 25 décrivent et interprètent chacune des vingt couches d'occupation. Dans la plupart des cas, un plan détaillé donne une image de l'arrangement des éléments et des artefacts, dont les fonctions sont interprétées à la lumière d'un ensemble de documents historiques et ethnographiques. Les vestiges fauniques sont étudiés en relation avec les nombreuses histoires taphonomiques afin de déterminer lesquels sont reliés aux activités humaines et lesquels proviennent d'autres sources.

Chacun de ces chapitres se termine par une synthèse de la description et des données de répartition afin d'établir ce qui aurait pu être le contexte socioculturel et historique de l'occupation. Par exemple, il semble que la composition et l'importance des groupes aient changé d'une occupation à l'autre. Des familles étendues et des microbandes semblent avoir occupé certaines couches d'après les restes trouvés de personnes d'âges divers et des deux sexes. Certaines autres couches portent les traces de groupes dont les tâches étaient plus spécialisées; on a ainsi trouvé des aires de travail extérieures, qui étaient utilisées principalement par les femmes. D'autres couches, toutefois, révèlent des feux de camp de groupes de chasseurs ou de guerriers, qui servaient principalement aux hommes. La plupart des occupations pour lesquelles on a pu déterminer la saisonalité ont eu lieu lorsqu'il faisait beau. Le dernier chapitre est une rétrospective qui met en évidence les principaux apports de la fouille et de l'analyse du site Sjovold ainsi que les changements qui sont survenus à travers les âges dans les systèmes culturels et les conditions environnementales.

L'existence du site est probablement due à la proximité d'un des quelques meilleurs passages fluviaux dans la région. La rivière Saskatchewan Sud, qui mesure environ 600 m de largeur presque tout le long de son cours, est profondément encaissée à travers la moraine et les dépôts sous-jacents de la fin du Tertiaire. Avant la venue des traversiers et des ponts, le passage par beau temps se faisait à l'aide de radeaux et autres petites embarcations. De forts courants de fond et des aires de sables mouvants décourageaient les nageurs et les piétons sauf les plus téméraires. Même les passages à l'aide d'embarcations comportaient aussi certaines exigences : pentes d'accès superficielles à base solide des deux côtés de la rivière, lit de rivière libre de barres de sable, bois pour la construction d'embarcations et terrains de campement des deux côtés pour y vivre pendant la construction des embarcations et le transport des personnes et des biens. Sjovold compte toutes ces caractéristiques et c'est le premier terrain de campement de passage fluvial des Plaines septentrionales à être décrit et étudié.

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Chapter 1

Setting the Stage

Introduction

This study describes the results of 1979-1980 excavations at a multicomponent campsite on the west bank of the South Saskatchewan River (see Fig. 1.1). The Sjovold site (pronounced sho' vold), located at the transition from grasslands to parklands in south central Saskatchewan, is designated "EiNs-4" in the Borden Uniform Site Designation System for Canada. It covers a 4000 year time span stretching from 2000 BC to the present, and contains one of the most detailed series of occupation layers yet known for the Northern Plains. Faunal remains clearly indicate that the occupants were principally bison hunters. Yet, in more than 20 separate episodes of occupation a surprisingly varied array of campsite activities is displayed — cooking, eating, tool manufacture and repair, gambling, sweat bathing and resting — most having occurred near surface hearths. The site was occupied primarily during warm seasons for periods lasting from hours to weeks. Represented groups extend from the Hanna complex through a series of Pelican Lake, Besant, Samantha, Avonlea, Moose Jaw and other Late Prehistoric occupations to Historic aboriginal peoples, pioneer picnics and even recent Boy Scout camps. The focus in this report is on the prehistoric occupations. Particularly noteworthy outcomes of the work include a detailed chronology for portions of the Middle and Late Prehistoric periods, a profusion of campsite features, some previously unrecognized, and a sufficiently well-preserved assemblage of remains to permit detailed layer by layer interpretations of activites. As a result of Sjovold site excavations we are beginning to understand the ancient history of a single locality and its relations to the surrounding area. One of our major conclusions is that this was an ancient river crossing campsite, a site type previously undocumented for the Northern Plains.

The site was discovered by Ralph and Leslie Sjovold during the summer of 1965. It is situated on crown land within a grazing lease, and is now protected by provincial heritage legislation. The site came to the attention of the Archaeology Section of the Saskatchewan Museum of Natural History (now Royal Saskatchewan Museum [RSM]) during the mid 1970s. The Museum was drawn to a closer examination by reports that it contained a small prehistoric component with pottery belonging to the Besant archaeological complex. Since the association of pottery with Besant was then a contentious matter, we hoped to resolve the issue at the Sjovold site. As often happens, however, the Sjovold site did not produce what was expected. Having determined from initial tests that this was a deep stratified multicomponent site, we decided to continue exploration of the full Sjovold sequence. Excavations required portions of two seasons, 1979-1980. When the principal investigator, Ian Dyck, moved to the National Museum of Man (now the Canadian Museum of Civilization [CMC]) he arranged completion of the study as a joint RSM/CMC project with Richard E. Morlan as collaborator.

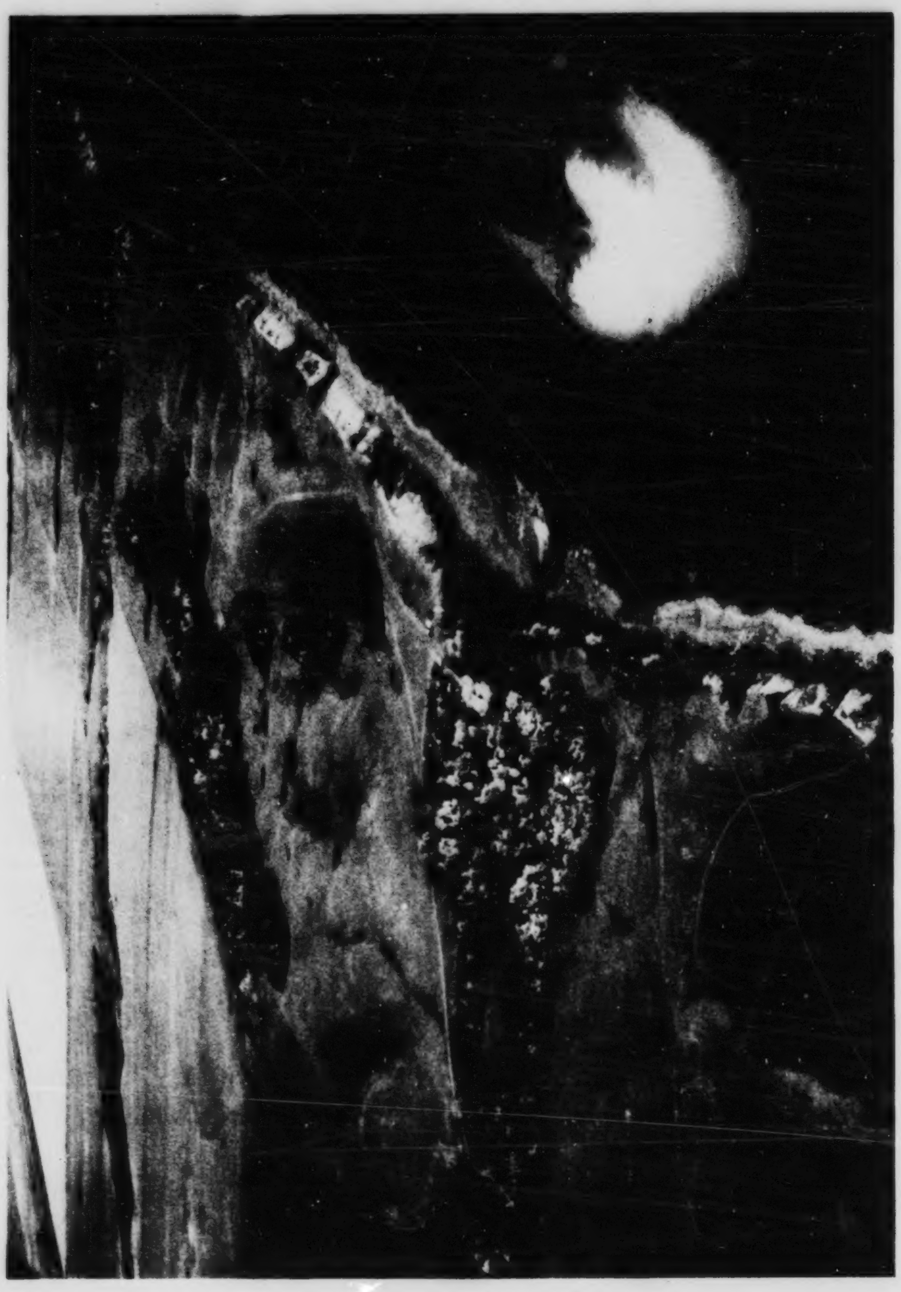


Figure 1.1. Oblique aerial view of the Sjovold site locality on the west bank of the South Saskatchewan River, in September 1980. Sjovold site excavations are visible at the center. RSM #EiNs-4: 80-019 CT.

The objectives of this report are (1) to situate the site in geographical and historical context; (2) to explain its significance to regional prehistory; and, especially, (3) to describe and interpret the occupation layers and their contents in terms of age, identity and activities represented. Most of the report "aims at drawing the completest possible picture of past human life in terms of its human and geographic environment" (Taylor 1948:95-96). Taylor used these words to describe his "conjunctive approach" to archaeological analysis. In the analysis of the Sjovold site we seek conjunctions among a variety of data sets that are arrayed on detailed planviews of the excavated area. The presentation of each occupation layer begins with the definition of any features that were recognized during excavation or analysis and proceeds with the content of several categories of collected materials — coarse rock, pottery, stone tools, chipped stone debris and cores, bone tools, and faunal remains. We consider not only the assemblage compositions of these categories but also particular attributes that are relevant to the interpretations of individual items. Whether a stone tool is broken or whole; whether it exhibits blood residue or distinctive edge damage; whether it is made of local or exotic raw material — all are attributes relevant not only to the tool itself but also to its site context, its association with features and other items. Whether a bison bone represents a bull or a cow; whether it was broken when fresh; whether it is marked by carnivore gnawing or by a stone tool — all are attributes that provide conjunctions among the total array of features and associated items. We base our inferences concerning past human behaviour on the entire set of relationships defined by such conjunctions, and the inferences were progressively modified during analysis as we brought more data into consideration. A given inference concerning the function of a feature, for example, might be modified or even dismissed in view of attributes recognized among the coarse rocks that were in the feature or its vicinity. In effect, each inference has certain test implications, and each data set may offer a test, sometimes rather unexpectedly. We hasten to add that this is not "the logically tautological practice of testing interpretations of the archaeological record against itself" (Sabloff, et al. 1987:206). We do not assume, *a priori*, any particular relationship among the data sets.

We do not endorse all aspects of Taylor's (1948) conjunctive approach. In particular we reject his concept of culture as a "mental construct" (Taylor 1948:101), because such a concept bars our access to an understanding of past cultures (see Leach 1973; Binford 1983:31, 1989:60-61). Nor do we follow his "procedures for the conjunctive approach" (Taylor 1948:152 ff.). As Binford notes, Taylor made a contribution by acknowledging the importance of inference in archaeological interpretation, but he "explored neither methods for making accurate inferences, nor for evaluating or verifying them once they had been made" (Binford 1983:32). To some extent this is an unfair criticism of Taylor, given the time at which he was writing. Radiocarbon dating had not yet been invented (Michels 1973:148 ff.). Ethnoarchaeology had not yet been conceived as a field of study (Kramer 1979). The first influential study of lithic use wear (Semenov 1964) was published in Russian nearly a decade after Taylor's study. Although a Russian scholar had already coined the word "taphonomy" (Efremov 1940), its influence in North American paleontology can be traced only to the 1960s and in archaeology to later decades (see Shipman 1981 for a review). The very concept of archaeological site formation processes (e.g., Schiffer 1987) owes much to this influence. These are merely a few of the lines of inquiry that provide "bridging theory" (Sabloff, et al. 1987:208) for the evaluation of our inferences.

Bridging theory is not, and is not intended to be, a substitute for fundamental scientific methods such as the method of multiple working hypotheses and the principle of uniformitarianism. Bridging theory has been derived from the growth of "middle-range theory" (Binford 1977:6) "which attempts to bridge the gap between the static archaeological record and the dynamic processes that produced it" (Rapson 1990:14). It helps to define plausible limits for hypothesis development, and it is instructive in hypothesis testing. An example may be taken from current trends in archaeological gender analysis. Ethnographic and historical sources reveal well defined gender roles — "the differential participation of men and women in social, economic, political, and religious institutions within a specific cultural setting" (Conkey and Spector 1984:15) — among northern Plains societies. However, this does not mean that projectile points always signify the presence of men and end scrapers the activities of women. It is essential to define the tasks performed and their social and spatio-temporal settings (Conkey and Spector 1984:25-26). In this study of the Sjovold site, we attempt such definitions for each of the twenty main occupation layers. We infer end scraper use by women during some occupations and by men during others. The distinction is derived from various bridging theories developed by additional resort to the ethnographic and historical literature. We draw multiple lines of evidence into interpretations of cultural context. As Taylor (1948:198) noted, this conjunctive approach, has high analytic costs but yields detailed results.

Chapter 1 sets the stage by outlining the environmental and historical context of the Sjovold locality and surrounding region. In Chapter 2 we summarize previous archaeological work at regional and local scales, and we describe the history, objectives and field methods of the Sjovold site investigations. The natural and cultural stratigraphy of the site are presented, along with a radiocarbon-based chronology, in Chapter 3. Chapter 4 previews the features and artifacts by explaining our laboratory methods and classificatory concepts. Chapter 5 previews the faunal remains with justifications for taxonomic assignments, taphonomic histories, and age/gender analysis. Collectively, these five chapters develop a framework for understanding the heart of the matter — detailed layer-by-layer analyses and interpretations in Chapters 6-25. Each occupation layer is given a chapter that describes and interprets features, coarse rock, pottery (when present), stone tools, chipped stone debris, bone tools, and faunal remains, in that order. This arrangement of topics should assist the reader to find particular subjects of interest. Chapters 6-25 contain with interpretive summaries that offer, for the reader in a hurry, a fast track through the book. Chapter 26 presents discussions and conclusions. Appendix A accounts for the assignments of the excavation levels to analytical layers. Appendix B gives the basis for the bison age and gender analysis. Appendix C lists abbreviations and codes used elsewhere in the book.

Environmental Setting

From a continental perspective, the study area is near the center of the physiographic division known as the Interior Plains that extend from the Arctic Ocean to the Gulf of Mexico. "The Interior Plains area of Canada encompasses the region between the Canadian Shield and the western Cordillera" (Vincent and Klassen 1989:99), and the study area is in the southern portion of this region. The southern Canadian Interior Plains are comprised mainly of three great subdivisions, from east to west the Manitoba Plain, Saskatchewan Plain, and Alberta Plain (Bostock 1970). These subdivisions were originally described as "three distinct *Prairie-levels*" (Hector 1861:393, emphasis his). The Sjovold site is located on the west edge of the second level, the Saskatchewan Plain, a level which is bounded on the east by the Manitoba Escarpment and on the west by the Missouri Coteau (Fig. 1.2; Hector 1861:394; Klassen 1989: Fig. 2.16). "Saskatchewan Plain lies mainly between 400 and 800 m a.s.l., and contains several higher areas such as Moose Mountain, Touchwood and Allan hills, and Wapawekka and the Waskesiu uplands" (Klassen 1989:140-141). Regional topography is controlled mainly by bedrock with lesser topographic features superimposed by glaciation (Scott 1971; Klassen 1989).

Most areas of the Saskatchewan Plain drain into the Beaver River, a tributary of the Churchill River in the north, or into the Assiniboine River and its tributaries, the Qu'Appelle and Souris rivers, in the south. The central portion, however, is drained by the North and South Saskatchewan Rivers (Fig. 1.2). Both of these large rivers enter the Saskatchewan Plain on easterly courses only to turn abruptly northward at prominent bends known as elbows. The elbow of the South Saskatchewan River was created by stream piracy during a complex deglaciation history involving a series of meltwater drainage channels, proglacial lakes, and isostatic rebound (see Scott 1971; Christiansen 1979; this volume, Chapter 3). The Sjovold site is situated on the west bank of the South Saskatchewan River, about 50 km downstream from the elbow, at the mouth of a former meltwater channel known as the Bratton Channel (Fig. 3.4). During deglaciation, sometime between 12,000 and 11,000 years ago, the Bratton Channel carried water from Glacial Lake Rosetown to Glacial Lake Birsay (Scott 1971:Fig. 29), and thence down the Qu'Appelle Channel to Glacial Lake Agassiz. Today this channel is locally known as the "Big Ravine" (Cohoon 1956:19) or as "Suicide Coulee," in reference to a period of difficult passage following ice damage to the Highway 45 bridge a few kilometres to the north (Oscar Sjovold, personal communication). It contains an underfit stream fed by springs, augmented seasonally by runoff, and influenced daily by variations in the discharge at Gardiner Dam located upstream about half way toward the elbow. Perhaps it was the influence of the dam that caused Scott (1971:5) to overlook this creek as one of the few perennial tributaries on the Rosetown map-sheet (N.T.S. 72-O). In this report we refer to this tributary by the informal name "Sjovold Creek."

From the elbow to the mouth of the South Saskatchewan River, informally known as the Forks, a distance of about 275 km, only nine creeks enter the river according to Hind (1971:395) who lists

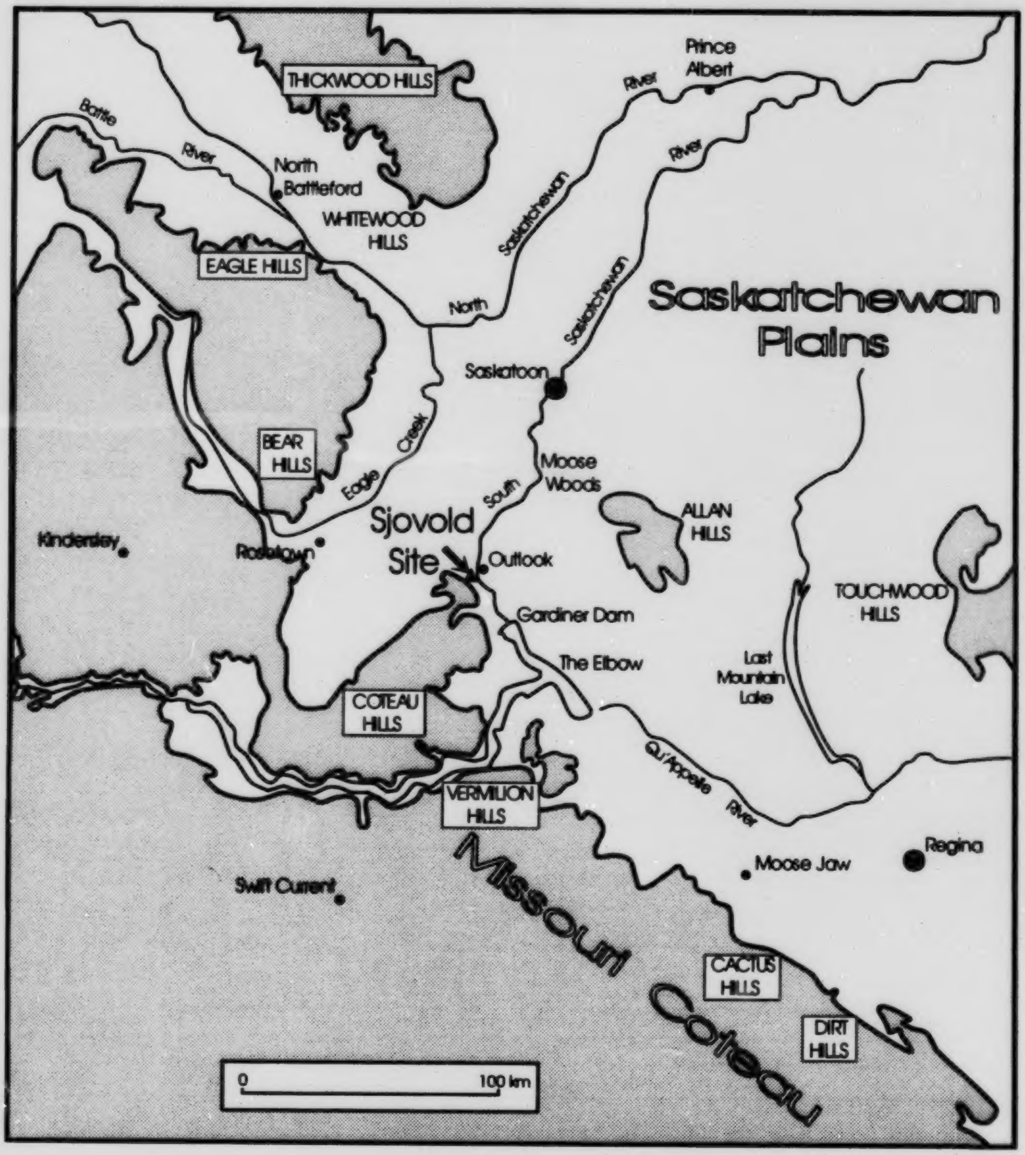

THICKWOOD HILLS
Prince Albert
River
Battle
River
North Battleford
WHITEWOOD HILLS
Saskatchewan
River
EAGLE HILLS
North
Saskatchewan
Saskatchewan Plains
Saskatoon
BEAR HILLS
Creek
Eagle
Moose Woods
South
Sjovold Site
ALLAN HILLS
Kindersley
Rosetown
Outlook
TOUCHWOOD HILLS
Gardiner Dam
The Elbow
Last Mountain Lake
COTEAU HILLS
Qu'Appelle
River
VERMILION HILLS
Regina
Moose Jaw
Swift Current
Missouri
Coteau
CACTUS HILLS
DIRT HILLS
0
100 km

Figure 1.2. Map showing the location of the Sjovold site in relation to major features of drainage and relief in central Saskatchewan (based on Richards and Fung 1969:42-43).

eight from the west and one from the east. Sjovold Creek is one of the smallest and shortest of these tributaries, but the size of the stream may have little to do with its importance as a landform for human use. Tipperary Creek, recently renamed Opimihaw Creek, just north of Saskatoon, is of similar size but holds extraordinarily rich archaeological deposits (Walker 1988b). The valley of Sjovold Creek has not yet been intensively surveyed for archaeological sites, but several factors lead us to believe that it holds great promise. In addition to the scant discoveries made in the area so far (see below), the physical setting of Sjovold Creek offers the combination of suitable terrain for crossing the South Saskatchewan River and access to the Missouri Coteau upland a short distance to the southwest. Along with other assets described below this setting may help to explain why the Sjovold site was occupied repeatedly over a period of four millennia.

The study area is situated in the northern part of the Palliser triangle (Palliser 1863) which is considered to be a northern extension of the arid plains of the United States (Scott 1971:5). It is near the northern edge of the semi-arid cold steppe according to the Koeppen climate classification (Richards and Fung 1969:52). Scott (1971:6) summarizes a 34-year precipitation record from the town of Outlook, 6 km downstream from the Sjovold site. It reveals average annual precipitation of 295 mm of which 26% falls as snow. Scott also reports for the Rosetown map-sheet an average annual temperature of 1.6°C with seasonal extremes ranging between -45.5°C and 40.5°C, noting that "wide variations in temperature, both daily and from day to day, occur at all times of the year (Scott 1971:6). Of more importance for daily life are the mean temperatures of the warmest and coldest months: 18.8°C in July, -16.1°C in January (Ellis, et al. 1968:14-15). In other words, this region offers pleasant summers but severe winters.

The study area is generally in the zone of dark brown chernozemic soils (Ellis, et al. 1968) and the mixed grass prairie (Harris, et al. 1983). The modern vegetation of the Sjovold site vicinity is well documented by a study commissioned during the site excavations (Abouguendia, et al. 1981). This study found a total of 184 species, representing 52 families of plants, including five tree species, 25 shrubs, 116 forbs, one fern, 30 grasses and seven grass-like species. Presumably due to greater aridity in the site area this is a lower floristic diversity than found in two studies farther north along the South Saskatchewan River — 271 species in an area south of Saskatoon (Hall 1973) and 291 species at the Batoche Historic site area some 160 km north of the Sjovold site (Abouguendia and Coupland 1976). Five major plant associations were identified in the Sjovold site vicinity (Abouguendia, et al. 1981). They are described below with landform terminology [in brackets] altered to conform to that used in Chapter 3 (see Fig. 3.4).

> The Green Ash - Manitoba Maple is the major forest association in the area. It occupies moist to very moist coulee bottoms and lower slopes in the [Eroded Areas]. This association is highly diverse both floristically and structurally. The dominant tree species are green ash (*Fraxinus pennsylvanica*) and Manitoba Maple (*Acer negundo*).

The shrub layer consists mainly of chokecherry (*Prunus virginiana*), northern gooseberry (*Ribes oxyacanthoides*) and snowberry (*Symphoricarpos occidentalis*). Numerous forbs are found here. Characteristic forbs include wild sarsaparilla (*Aralia nudicaulis*) and Canada anemone (*Anemone canadensis*). The graminoid component is rather poor in this association.

The Snowberry - Saskatoonberry Association occupies mainly moist slopes, coulee bottoms and depressions in the [Eroded Areas] and the [Lacustrine and Aeolian Plains]. The tree component in this association is usually minor. This association exhibits less floristic diversity than the preceding association. The main shrubs here are snowberry, saskatoonberry (or Saskatoon serviceberry *Amelanchier alnifolia*), rose (*Rosa woodsii*) and northern gooseberry. Northern bedstraw (*Galium boreale*) is the main forb species in this association.

The Spear Grass - Wheatgrass Association occupies mainly the well-drained upland and upper slopes in the [Lacustrine and Aeolian Plains]. This land type is characterized by fine-textured soils. The species composition of this association is typical of the Mixed Prairie Grassland, i.e. the zonal vegetation type. This association shows the least diversity both floristically and structurally. The shrub component is essentially absent here. The predominant vegetation is of the graminoid type consisting mainly of porcupine grass (*Stipa spartea* var. *curtiseta*), spear grass (*Stipa comata*) and wheatgrasses (*Agropyron dasystachyum* and to a lesser extent *A. smithii*). Associated forbs include pasture sage (*Artemisia frigida*), skeleton weed (*Lygodesmia juncea*), dotted blazingstar (*Liatris punctata*) and spiny ironplant (*Haplopappus spinulosus*). Overgrazing by domesticated livestock appears to result in changes in species composition in this association. Overgrazed areas show increase in pasture sage, little clubmoss (*Selaginella densa*) and blue gramma (*Bouteloua gracilis*) and decrease in porcupine grass and northern wheatgrass.

The Spear Grass - Sand Grass Association occupies the [Outwash Plains and Dunes east of the River] characterized by relatively coarse-textured soils. The shrub component in this association is very prominent and consists mainly of creeping juniper (*Juniperus horizontalis*) and hoary sagebrush (*Artemisia cana*). Dominant grasses include spear grass and sand grass (*Calamovilfa longifolia*). Porcupine grass is almost absent from this association apparently due to the drier, coarse-textured soils.

The Willow - Graminoid Association is found on the [Flood Plains]. Because this [landform] is subject to frequent flooding and ice scouring, only graminoid and shrub growth forms are able to survive this harsh habitat. Species composition in this association is quite variable depending mainly on soil moisture condition. The low-lying areas consist mainly of herbaceous vegetation dominated by creeping bentgrass (*Agrostis palustris*). Many other graminoid and forb species are found here. Occasional sandbar willow (*Salix interior*) may be found. The upper portions of the [Flood Plains] support a more substantial shrub component dominated by sandbar willow. The graminoid and forb components in such areas contain more xerophytic species than those found in the low-lying areas.

Abouguendia, et al. (1981) conclude that "some relicts of the natural vegetation ... [indicate] ... that a mixed prairie grassland type ... must have dominated the presettlement vegetation of the upland in this region. There is no evidence of any substantial human-induced changes in the vegetation of the other associations found in the study area." They also note that a large number of the vascular plant species found in the Sjovold site vicinity are known to have been useful to the native people of the area and that the high habitat diversity and significant tree and shrub components would have supported a diverse fauna. In addition they note the presence of many plant taxa known to be utilized by large game animals: 10 taxa used by deer, 11 by pronghorn, 14 by bison, and 23 by wapiti (Abouguendia, et al. 1981: Appendix D). Remains of all four of these game animals are present among the Sjovold site faunal remains, but the assemblages are generally dominated by the bones and teeth of bison.

Although the modern local vegetation is well known, the presettlement proximity of the aspen parkland community is not clear from existing literature. Some sources indicate that the aspen parkland exists along the South Saskatchewan River only downstream from the Sjovold site (Bird 1930, 1961; Harris, et al. 1983). Others illustrate a substantial area of aspen parkland upstream from the site around Elbow and extending in some cases nearly to Outlook (Breitung 1953; Kabzems, et al. 1976; Rowe 1972). Archibold and Wilson (1980) used the 1880s Dominion Land Survey to reconstruct the natural vegetation prior to agricultural settlement, and their map of woodland cover shows up to 15% woodland along the river from the elbow to Range 8/Township 28, where the Sjovold site is located, and almost continuously along the river northward from there (ibid.: Fig. 4). Palliser (1863) draws the "northern limit of true prairie land" precisely at the Sjovold Creek valley. In view of the cultural significance of the parkland belt (e.g., Meyer and Epp 1990; Ray 1972), this is a matter of some importance, but it will probably be necessary to reconstruct the former position of the aspen parkland by analyzing archaeologically recovered charcoal.

Obviously the setting of the Sjovold site at the mouth of a creek valley offers locally enhanced environmental diversity that is manifest in both the soil types (see Chapter 3) and the biotic community. The importance of such local enhancement would depend on the proximity of aspen parkland. If the southern extent of the parkland were as far north as Saskatoon (e.g. Harris, et al. 1983), the Sjovold Creek valley would represent a veritable oasis to people travelling across the open grasslands. If the parkland extended nearer, the Sjovold site area would serve as part of a larger ecotonal boundary with the enhanced productivity that is usually implied by such settings (Epp 1984). Indeed the Sjovold vicinity is on or near a major zonal boundary on most zoogeographic maps including Merriam's (1892) life zones, Dice's (1943) biotic provinces, and Hagmeier's (1966) mammal

Table 1.1. Zoogeographic affinities and status of mammals at the Sjovold site locality.*

	Zoogeography				Sjovold site	
Taxon	WS	PL	BM	EA	Past	Present
Order Insectivora						
Family Soricidae						
Sorex haydeni (Prairie Shrew)	-	+		-	e	+
S. hoyi (Pigmy Shrew)	-	-	+	-	e	+
Order Chiroptera						
Family Vespertilionidae						
Myotis lucifugus (Little Brown Bat)	+	-	-	-	e	+
Lasionycteris noctivagans (Silver-haired Bat)	+	-	-	-	e	+
Eptesicus fuscus (Big Brown Bat)	+	-	-	-	e	+
Lasiurus borealis (Red Bat)	-	-	-	+	e	+
L. cinereus (Hoary Bat)	+	-	-	-	e	+
Order Lagomorpha						
Family Leporidae						
Sylvilagus nuttallii (Nuttall's Cottontail)	-	+	-	-	+	?
Lepus americanus (Snowshoe Hare)	-	-	+	-	+	+
L. townsendii (White-tailed Jackrabbit)	-	+	-	-	+	+
Order Rodentia						
Family Sciuridae						
Tamias minimus (Least Chipmunk)	-	-	+	-	+	+
Spermophilus richardsonii (Richardson's Ground Squirrel)	-	+	-	-	+	+
S. tridecemlineatus (Thirteen-lined Ground Squirrel)	-	+	-	-	e	+
S. franklinii (Franklin's Ground Squirrel)	-	+	-	-	e	+
Family Geomyidae						
Thomomys talpoides (Northern Pocket Gopher)	-	+		-	+	+
Family Heteromyidae						
Perognathus fasciatus (Olive-backed Pocket Mouse)	-	+	-	-	e	+
Family Castoridae						
Castor canadensis (Beaver)	+	-	-	-	+	+
Family Cricetidae						
Peromyscus maniculatus (Deer Mouse)	+	-	-	-	+	+
Onychomys leucogaster (Northern Grasshopper Mouse)	-	+	-	-	e	+
Clethrionomys gapperi (Gapper's Red-backed Vole)	-	-	+	-	+	+
Ondatra zibethicus (Muskrat)	+	-	-	-	+	+
Microtus ochrogaster (Prairie Vole)	-	+	-	-	e	+
M. pennsylvanicus (Meadow Vole)	-	-	+	-	+	+
Family Zapodidae						
Zapus princeps (Western Jumping Mouse)	-	-	+	-	?	+
Family Erethizontidae						
Erethizon dorsatum (Porcupine)	+	-	-	-	+	+

Table 1.1 (continued).

Taxon	Zoogeography				Sjovold site	
	WS	PL	BM	EA	Past	Present
Order Carnivora						
Family Canidae						
Canis latrans (Coyote)	+	-	-	-	?	+
C. lupus (Wolf)	+	-	-	-	+	†
C. familiaris (Dog)	+	-	-	-	+	+
Vulpes vulpes (Red Fox)	+	-	-	-	e	+
V. velox (Swift Fox)	-	+	-	-	+	†
Family Ursidae						
Ursus americanus (Black Bear)	+	-	-	-	e	†
U. arctos (Grizzly Bear)	+	-	-	-	+	†
Family Procyonidae						
Procyon lotor (Raccoon)	+	-	-	-	e	+
Family Mustelidae						
Martes pennanti (Fisher)	-	-	+	-	+	†
Mustela erminea (Ermine)	-	-	+	-	e	+
M. frenata (Long-tailed Weasel)	+	-	-	-	e	+
M. nivalis (Least Weasel)	-	-	+	-	e	+
M. vison (Mink)	+	-	-	-	e	†
Gulo gulo (Wolverine)	-	-	+	-	e	†
Taxidea taxus (Badger)	+	-	-	-	+	+
Mephitis mephitis (Striped Skunk)	+	-	-	-	+	+
Lutra canadensis (River Otter)	+	-	-	-	+	†
Family Felidae						
Felis concolor (Cougar)	+	-	-	-	e	†
Lynx lynx (Lynx)	-	-	+	-	+	†
Order Artiodactyla						
Family Cervidae						
Odocoileus hemionus (Mule Deer)	+	-	-	-	?	+
O. virginianus (White-tailed Deer)	+	-	-	-	?	+
Alces alces (Moose)	-	-	+	-	+	†
Cervus elaphus (Wapiti)	+	-	-	-	+	†
Family Antilocapridae						
Antilocapra americana (Pronghorn)	-	+	-	-	+	+
Family Bovidae						
Bison bison (Bison)	+	-	-	-	+	†

a. Zoogeography after Jones, et al. (1983); modern distributions after Beck (1958), Banfield (1974), and van Zyll de Jong (1983). Zoogeographic affinities: WS, widespread; PL, Plains and Great Basin; BM, Boreal and Montane; EA, Eastern. Past: e, expected; +, identified among the Sjovold site faunal remains. Present: +, now living in the Sjovold site area; †, extirpated from the area.

provinces (see Scudder 1979). This is illustrated by the zoogeographic affinities of the mammals among which Plains and Great Basin species are matched in number by Boreal and Montane species (Table 1.1).

The summary of mammal species in Table 1.1 exhibits a degree of diversity seen also in south-central Saskatchewan birds (Houston 1993) and many other animal groups (Atton 1993; Danks 1979). We use the mammals to illustrate this fact because they are the class of animals best represented among the Sjovold site faunal remains. We have identified about half of the 50 species listed among bones and teeth from the site, and this number is limited mainly by our recovery techniques (¼" screens; finer screening or flotation would undoubtedly provide a more complete record of small mammals. Approximately a quarter of the mammal species known historically in the area have been extirpated mainly by widespread agricultural practices and attendant habitat destruction (see Epp 1993a), including eight widespread species, one Plains and Great Basin species, and four Boreal-Montane species. Just as mammal species respond individually rather than as communities to climatic changes (Graham 1985, 1990), they also exhibit individual species responses to these anthropogenic changes. Such responses are reinforced by human targeting of ungulates as game and carnivores as fur-bearers or vermin.

Just as we know archaeologically and zoogeographically that the biota formerly was richer in species, we also know historically it was very abundant. Early historical accounts speak repeatedly of the landscape teeming with wildlife. Anthony Hendry describes "the Buffalo so numerous [we were] obliged to make them sheer out of our way. Also Wolves without number..." (Burpee 1907:333). He mentions beaver and otter "swarming about us in the creeks and swamps" (ibid.:342), and "Moose and Waskesew [Wapiti] passing and repassing in herds, within 200 yards of our tent" (ibid.:343). Overhead were "countless multitudes of [Passenger Pigeons], which darken the air for hours and miles together in their flight" (Sabine 1823:679).

Obviously it was not always like this. The winter season required careful planning, preparation of stored provisions such as pemmican, and resort to sheltered areas with a reliable supply of fuel. However, the growing season afforded a variety and abundance of resources that can scarcely be imagined by the twentieth century mind.

Coarse stone resources are abundant in the Sjovold area in pebble, cobble and boulder form, these being a prominent component of the glacial tills which blanket the region. Included are igneous, metamorphic and carbonate rock types (Scott 1971:10). Such rocks appear on many surfaces, but are especially concentrated in creek and river valley walls and floors where erosion has removed finer fractions of till matrix leaving rock concentrations known as "lag." Valley walls and stream beds adjoining the Sjovold site are dotted with rocks eroding or eroded out of till, the most common materials being granite, gneiss, quartzite, sandstone, limestone, and basalt/andesite (Dyck 1990).

These could provide ready sources of stone for many uses - as agents for heat transfer in boiling, roasting and steaming processes of cooking, ablutions and manufacturing; cobbles for hammerstones and abraders; grit (in crushed form) for temper in pottery; weights for tent covers; and a limited range of chippable materials (quartzite, basalt, andesite) for large edged tools.

Sources of high quality fine-grained chipping materials are not known for the Sjovold district. However, it has long been suspected that materials of intermediate chipping quality, specifically silicified peats and woods, were available from local sources since those materials are well represented in local artifact collections. The most likely source for such materials is deposits of Late Tertiary age (Johnson 1986:25-28), but until recently it was believed that such deposits were absent from the Sjovold district (Scott 1971:7). Research by Johnson (1986:61, 71-81) has revealed deposits containing silicified peat and wood in Macrorie and Birsay sections of the South Saskatchewan River Valley. These may be of Late Tertiary age. Recent geological work by E. Christiansen, opposite the town of Outlook, has led to the first positive identification of Late Tertiary deposits in the region. These cap a river terrace and contain nodules of silicified peat and silicified wood and pebbles of chert (pers. comm., E. Christiansen to I. Dyck, July 1994). Thus, it appears that Late Tertiary deposits bearing silicified peat, silicified wood and pebble chert are exposed in the walls of the South Saskatchewan River Valley at several locations north and south of the Sjovold site, and these were probably important local sources of finer chipping materials in earlier times.

Historical Setting, AD 1690-1860

Interpreting the cultural context(s) within which Sjovold site remains were laid down is a complicated task. We found it useful, as an aide to our interpretations, to make a brief survey of historic literature concerning aboriginal peoples who have occupied the site locality and surrounding area. It is, of course, possible that the activities of prehistoric peoples at the Sjovold site bore little resemblance to those of historic native peoples, but that seems unlikely. The prehistoric archaeological record at the Sjovold site, from Layer I to Layer XXI, is that of temporary occupations by prehistoric bison hunters. Early historic occupants of the area were also buffalo hunters and their history, logically, holds considerable potential for comparisons.

Although we were interested in questions of continuity and discontinuity between prehistoric and historic ethnic groups, that has not been the focus of our interest. For one thing, the historical literature does not lend itself to such a specific focus for the Sjovold locality. For another, the contact period is one of the weakest in the Sjovold site record. Therefore, we have simply attempted to assemble a body of historic observations that bear on the region surrounding the Sjovold locality and that are as quantitative and particular as possible. We sought a general appreciation, for example, about a variety of topics and questions: the South Saskatchewan River as a possible boundary between buffalo hunting groups; the river as a potential obstacle to travel; seasons of the year during which people might have camped at the edge of the river; local resources that might have attracted people; potential group sizes that might have used the locale; whether the area was part of a single group's territory or was used by more than one group; regional population sizes; regional trade; causes and pace of changes in land use and occupancy; and so forth. The historic record was not always forthcoming, but it does contain clues and some answers to these questions that are useful for the interpretation of prehistoric occupations.

We chose the period AD 1690-1860 for several reasons. It is as close to prehistoric times as we can get, and the time span is sufficient to allow detection of long term changes. Although peripheral to our needs, the review also gives us a glimpse of the nature, impact and timing of European influences. We are mindful of the fact that there is a substantial ethnohistoric literature about Northern Plains Indians pertaining to the 1850-1920 period and later (cf. Weist and Sharrock 1985). Such literature is of enormous value to a study such as ours even though it seldom, if ever, makes specific reference to the Sjovold locality. We make reference to that literature only as needed. There are also several regional historical studies pertaining to our review period and to adjoining or overlapping geographic areas (Brink 1986; Nelson 1973; Ray 1972, 1974; Russell 1982, 1988, 1989, 1991). These are useful but, having been made for other purposes, do not fully serve our needs. The same applies to several broader historical studies (Campbell 1950; Friesen 1984; Magne, et al. 1987; Morton 1973; Warkentin 1964; Williams 1983).

The area we considered is roughly circular, about 450 km in diameter, and centered on the Sjovold site. Occasionally we reach slightly farther afield. In doing this work we have gained a finer appreciation for the research of previous scholars, particularly that of Dale Russell (1991) who has covered some of the same ground. Matters for which we found useful information are: (1) identities and distributions of native populations; (2) tribal feuds and alliances; (3) travel patterns and distances; and (4) a couple of specific instances of native use of the Sjovold locality. One cannot read the historical records without noticing many references to topics such as material culture and social practices. However, those topics are so well covered in the ethnohistoric literature that their inclusion here, except for the odd reference, seems unnecessary.

Henry Kelsey's 1690-1692 journal of a trip from York Factory to the Canadian prairies marks the beginning of written history for south-central Saskatchewan (Epp 1993b). Kelsey, a young Hudson's Bay Company employee, undertook his famous trip in order "to discover & bring to a Commerce the Naywatame poets" (Doughty and Martin 1929). Just who these Naywatame poets were is a puzzle. They have been Gros Ventres (Morton 1973:113). A complicating factor with this identification is that Gros Ventres, as used by historic observers, included not only Algonkian-speaking Atsina, but also Siouan-speaking Hidatsa (Russell 1991:200-212). Kelsey was guided and accommodated by Assiniboine Indians who brought him into their homelands in the parklands of east-central Saskatchewan and beyond the parklands into the prairies, possibly as far as the Touchwood Hills (Morton 1973:112). The latter he found to be occupied by "Mountain" Assiniboines. In the vicinity of the Touchwood Hills the Kelsey party also hoped to find Naywatame poets. He had been advised that there was enmity between the Nayhaythaway Indians (Cree) and the Naywatame poets. Crees had recently killed six Naywatame poets and in retaliation, during the spring of 1691, Naywatame poets killed three Cree women and then fled far into the prairies. However, Kelsey and his Assiniboines persevered and eventually were approached by Naywatame poets about a hundred miles northeast(?) of the Touchwood Hills. Kelsey tried to convince them that it would be safe to come to York Factory to trade, and he received an indication that they would do so. However, that winter Crees killed two more Naywatame poets which put an end to the York Factory trip. In any case, Kelsey's observations show that both Mountain Assiniboines and Naywatame poets occupied the area north of the Qu'Appelle River and east of the South Saskatchewan River during the late 1600s. Since that region lies only 100-175 km east of the Sjovold site, it seems probable that both groups would have known the Sjovold locality.

The next useful record is that of Anthony Hendry (Burpee 1907). During 1754-1755, in the company of some 400 Cree Indians, Hendry crossed the South Saskatchewan River below Saskatoon, travelled to the elbow of the North Saskatchewan River, and followed the North Saskatchewan River west to about Battleford. There, they turned southwest toward the Neutral Hills. From Battleford onward the route is controversial. Current scholarly consensus seems to favour a return by the North Saskatchewan River (Morton 1973; C. Wilson 1974; Russell 1991). We favour a return by the South Saskatchewan River (Burpee 1907) because such a route makes by far the best fit with Hendry's distances and compass directions (magnetic declination taken into account), and because the places he mentions for bison hunting and meeting Archithinues on the return trip are easily plotted if they occurred on the South Branch, but difficult to locate on the North Branch. Accordingly, Hendry and his party continued into east-central Alberta and crossed the Red Deer River a little above Knee Hills Creek. About 20 miles beyond the Red Deer River they finally caught up with a camp of 200 Archithinues [Blackfoot] whom they had been following since reaching the elbow of the North Saskatchewan. After several days visit with them, Hendry and his group spent the rest of the winter dispersed in small groups in central Alberta around the upper parts of the Red Deer River. In spring they made canoes and paddled down the Red Deer, South Saskatchewan and Saskatchewan rivers back to York Factory.

It is worth noting the kinds of Indians that Hendry encountered. On September 1, 1754, on the north edge of the Eagle Hills they came upon 24 tents of Assiniboines. On September 4, near the mouth of the Battle River their guide brought them two Archithinues on horseback. Then they travelled westward, south of the Battle River, where they found "a great many Asinepoet Indians" [Assiniboines] on September 5. They continued southwest 10 miles and on September 6 encountered five tents of Mekesue or Eagle Indians whom Hendry identified as belonging to the Assiniboine nation.

On September 7, they saw a dead buffalo with Archithinue arrows in it. On September 17 in the Neutral Hills, two young men from Hendry's party had an unfortunate encounter with a grizzly bear: "One may recover but the other never can; for his arm is almost tore form his body, one eye is quite out, and his entrails are hanging from his body..." On the next day two Assiniboines came to Hendry and told him that Archithinues had killed and scalped two of their people and that a great many Archithinues were nearby. Hendry continued west and on September 20 came to 7 tents of Assiniboines. On September 28, they were joined by several tents of Assiniboines, and on September 29 by more Assiniboines and two Archithinues on horseback. On 30 September, they were joined by more Assiniboines. Then on October 1, about 50 miles northeast of the Red Deer River, they were approached by seven tents of Archithinue Indians. Hendry and his party continued southwest, crossed the Red Deer River and spent October 14-17 in the company of some 322 tents of Archithinue Indians. After parting from them, the Hendry party broke up into smaller hunting groups who spent the winter around the upper reaches of the Red Deer River without much contact with other Indians. However, on February 10, 1755 four Indian men told Hendry that "far distant Archithinue Natives had killed 30 of the nigh ones & 7 of our Indians." Later in February Hendry was joined by "different tribes of Natives, who yearly visit our Settlements: they brought with them several Archithinue Women & Children Captives, with many Scalps quite green."

In late March 1755, Hendry's party reassembled on the Red Deer River and built canoes for the trip home. Assiniboines were doing the same things a little downstream. On April 28, the Hendry party embarked with 20 canoes of Assiniboines. Fifty miles downstream they found Hendry's Cree guide and a great many others, twenty canoe loads of whom joined them on May 1. About May 12, when they were in vicinity of the Sjovold site on the South Saskatchewan River, they met 100 tents of Archithinues and traded a great many wolf skins from them. On May 15, in the vicinity of Saskatoon, they met another 127 tents of Archithinues and traded for a great many more wolf, beaver and fox skins. On 16 May, along the stretch of the South Saskatchewan River between the Warman and Hague ferries, they traded with another 30 tents of Archithinues. Hendry commented that the Archithinues, "have the finest Horses I have yet seen here, and are very kind people." At the same place on May 17 they were joined by 10 tents of Eagle Assiniboines, five canoe loads of them intending to accompany Hendry downstream. During the next three days the sixty-five canoe flotilla paddled downstream 72 miles and, upon arriving at what would later be the "South Branch Houses" locality, they met their last group, 70 tents, of Archithinue natives. The leader of this group was the same leader who had entertained Hendry in the great Archithinue camp on October 14-17 of the previous year. Hendry and his companions paddled onward soon reaching the forks of the North and South Saskatchewan Rivers and, not long after that, the westernmost fur trading post of that time, Fort St. Louis (Morton 1973:238). Leaving Fort Saint Louis, they moved beyond our area of interest.

The important things to note in respect to native peoples are that: (1) the main people actually encountered during the trek between the South Saskatchewan and the Neutral Hills were Assiniboines.

It seems reasonable to assume that this arc of Assiniboines lying some 80-225 km north and west of the Sjovold site would have included the Sjovold site within their hunting territory; (2) Hendry did meet two mounted Archithinues as early as arriving in the Battleford area and knew that a large group of their people had been travelling just in front of him all the way from the elbow of the North Branch; (3) his main encounters with Archithinues were southwest of the Red Deer River and, on the return trip, in trading rendezvous, along the middle and upper reaches of the South Branch; (4) a large group of Crees and Assiniboines were able to travel deep into Archithinue territory with little obstruction and conversely, Archithinues were able to travel, albeit in large groups, to the upper reaches of the South Branch without difficulty; and (5) Archithinues were sometimes at war among themselves, possibly Atsina versus Blackfeet.

Although Hendry and several others made additional trips into the Northern Plains and Parklands during the years following 1755, records of those trips have either been lost or are difficult to interpret (Russell 1991:84-118). The next fur trader to leave a good record of prairie travels was Matthew Cocking in 1772-1773 (Burpee 1908; Morton 1973:284-286; Russell 1991:105-108). We pick up his journey on August 22, 1772 in the vicinity of later South Branch Houses on the South Saskatchewan River. Travelling in the company of a band of Crees, Cocking met another 14 tents of Crees who were going upriver in pursuit of buffalo. Cocking's party, however, crossed the river and continued southwest until they arrived at the North Branch of the Saskatchewan River. Once there they travelled upstream along the south side of the river and on September 3, at about the elbow, they meet a Frenchman and a few Assiniboines. Continuing to the mouth of Eagle Creek they came upon many natives gathering berries, but Cocking does not identify the tribe. Turning south, Cocking and his party entered the Eagle Hills and generally followed Eagle Creek to the south. On September 13, three Assiniboines came to them from Manito Lake 200 km to the northwest and said that Assiniboines in that area were feuding among themselves. On September 18, when Cocking was camped a few kilometers northwest of the present town of Laura, about 50 km northwest of the Sjovold site, 10 tents of Assiniboines came to them from a mixed camp of Assiniboines and Archithinues located two days journey west of Manito Lake. Four days later those Assiniboines returned to the northwest. At the same time a substantial number of Cocking's Cree and Assiniboine companions departed east toward the Moose Woods to trap wolves and pound buffalo. This left Cocking with only eight tents. They continued up the Eagle Creek Valley to the southwest. On October 5, north of Herschel, two more tents separated and went south. Meanwhile, Cocking and his six remaining tents continued along the south edge of the Bear Hills.

Near Ruthilda, about 100 km northwest of the Sjovold site, they arrived at a ledge of poplars where most of his group intended to spend the winter trapping. However, two more tents moved north leaving Cocking with four tents. Between October 16-19 they saw smoke which they supposed to from nearby camps of "our Friends the Archithinue Natives." Cocking's companions also showed him an Archithinue tobacco plantation which was about 100 yards long by 5 yards wide and was sheltered by a "Ledge of Poplars" to the north and high ground to the south. The plantation indicates that the Archithinue were longer term occupants of the area. On October 22 Cocking and his party went to an old Archithinue buffalo pound a short distance to the southwest. The pound had been made the previous spring and needed repairs which Cocking and his friends undertook. Once it was fixed they tried to drive buffalo into it, without success. This prompted Cocking's comment that "We are not so expert at pounding as the Archithinue Natives." On November 4 Cocking's companions began to lose hope of seeing Archithinues which was a great disappointment to them. They had been expecting to obtain horses and buffalo skin garments, wolf skins and other furs in trade. At this point Cocking makes the following comment about Archithinue location: "they have dealings with no Europeans, but live in a state of nature to the S.W.Westerly: draw towards the N.E. in March to meet our Natives who traffick with them" (Burpee 1908:110).

On November 11, three more tents left Cocking and returned to the Eagle Hills. Cocking decided to stay on with only three tents of companions in the hope of doing some trapping. Over the next week they saw smoke to the south which they feared might be from camps of Snake Indians. However, on October 21 two Archithinues came to their camp from the south saying that they were part of a group of 28 tents who would join Cocking now that they knew his party was friendly. On December 1 some 21 tents of equestrian Archithinue arrived. Since both Cocking's leader and one of the Archithinue leaders knew Assiniboine that was the language of communication although there may have been no Assiniboines in the camp. The Archithinue explained that they were Poestic-Athinuewuck or Water-fall Indians, in other words Fall or Gros Ventres. They said that there were four other tribes of equestrian Indians, namely, Mithco-Athinuwuck or Bloody Indians [Bloods], Kostikow-Wathesitock or Blackfooted Indians [Blackfoot], Pegonow or Muddy-water Indians [Piegan], and Sassewuck or Woody Country Indians [Sarcee]. The Fall Indian visitors made their meals in clay pots of their own manufacture — like Newcastle pots without feet. They made fire using a black stone as flint, a kind of ore as steel, and "tuss balls" as tinder. The Fall Indians added further repairs to the pound, those of Cocking's people being insufficient, and within three days were able to drive bison into it. On December 14, three Fall Indians of the same group arrived from the west and said that buffalo were becoming scarce and that their countrymen were going to war with the Snake Indians. On December 16, Cocking left his Fall Indian friends and headed back to the Eagle Hills being joined enroute by 10 tents of Assiniboines and five tents of Crees. Cocking worked his way northeastward back and forth across the North Saskatchewan River meeting other groups of Assiniboines and Crees before embarking in Canoes for the return to York Factory.

It is important to note that in Cocking's experience Assiniboines were the predominant occupants of lands lying between the forks of the Saskatchewan River and the Eagle Hills, and extending at least 60 km south of the North Saskatchewan at the Eagle Hills. Cree seem to have associated quite freely with Assiniboines in this territory. Fall Indians occupied the lands to the south and had a trading relationship with Assiniboines and Crees which brought them north into the Bear

Hills area on a regular basis. Beyond or among the Fall Indians lived people referred to as Snakes who were enemies of the Fall, Assiniboine and Cree. Snakes raided into the extensive area between the forks of the north and south branches of the Saskatchewan River. Beside Fall Indians, other Archithinues included Bloods, Blackfeet, Piegans and Sarcees. Their lands were generally southwest of the Bear Hills. All of this is consistent with and amplifies information from the Kelsey and Hendry explorations.

Table 1.2. Native Peoples Trading at Hudson's Bay Company Hudson Houses on the North Saskatchewan River between Fall 1778 and Spring 1782.[a]

Tribe	Nation	1778-79	1779-80	1780-81	1781-82	Total
Unidentified	Unknown	143 +3	61 +1	443 +7	184 +3	831 + 14
"	Barren Land	0	0	3	15	18
Assiniboine	Stone	51 +3	148 +5	47 +2	2 +1	248 + 11
"	Swampy Gnd Stn	0	0	2	49	51
Cree	Beaver Country	5	96	13 +3	8 +1	122 +4
"	Pegogemew	0	22 +1	0	84	106 +1
"	U'Basquia	0	7	0	0	7
"	Sturgeon River	0	5	0	0	5
"	Southward	0	0	7 +1	0	7 +1
Fall	Fall	0	14	18	4	36
Blackfeet	Blackfeet	0	0	0	14	14
Total		199 +6	353 +7	533 + 13	360 +5	1445 + 31

a. Three kinds of enumeration were used by Hudson House journal keepers: (1) counts of individuals, (2) counts of tents or families, and (3) indefinite sums such as a few, some, gangs, or just Indians. In making this table, we have calculated numbers of individual persons by summing actual individual counts and adding tent or family counts at seven persons each. Following some individual counts there are additional numbers, prefixed by a "+", that indicate the number of times additional uncounted visitors were seen.

During the late 1770s, fur trade posts began to appear at the edge of prairie country along the North Saskatchewan River. Among the first were Upper and Lower Hudson Houses (Rich, et al. 1951, 1952), about 180 km north-northeast of the Sjovold site. Daily journals kept at those posts by Hudson's Bay Company employees during trading seasons from 1778 to 1782 supply a glimpse of the tribes who were coming to trade (see Table 1.2). Although estimates are rough and more than 50% fall into the unidentified category, our figures suggest that the major Hudson House clients were Assiniboines and Crees. Fall Indians were a distant third in importance and Blackfeet an even more distant fourth. From this evidence we suspect that Assiniboines were the dominant local group, but that Cree, both local and from distant points to the east, north and especially northwest, combined to be almost equal in numbers to the Assiniboines.

Several noteworthy events occurred along the North Saskatchewan River during these years. For example, on 22 April 1779 a fight erupted between Cree Indians and fur traders at posts upstream from Hudson House. Ill use of Indians by individual opposition traders caused a fight which ended in the deaths of two Crees and two traders (Rich, et al. 1951:331-332; Tyrrell 1934:224-228). This was clearly a quarrel among individuals rather than a strategic attack. During the fall of 1780, Indians burned all the plains areas near Hudson House in an attempt to control hunting and the flow of provisions to their own advantage. However, the timing of the burning was particularly unfortunate as it coincided with a more widespread game shortage. The result was great privation among the natives and a reduced trade. Added to the starvation of 1780-81 was a general epidemic of the "White Flux," a sort of lung or breast disease which one trader commented, "the Whole of the Indians has been complaining of ever since I have been up this year..." (Rich, et al. 1952:168).

The following year, 1781-1782, Northern Plains Indians were devastated by a widespread smallpox epidemic. Daily scenes of death confronted Hudson House traders. Due to shortage of provisions some of the post's men were sent into the plains to feed themselves and one of them, Mitchell Omen, returned with a graphic description of an Indian camp afflicted with the disease:

> ...we preceeded about 150 miles up the River to the Eagle Hills, where we saw the first camp and some of the people sitting on the beach to cool themselves, when we came to them, to our surprise they had marks of the small pox, were weak and just recovering...none of us had the least idea of the desolation this dreadful disease had done, until we went up the bank to the camp and looked into the tents, in many of which they were all dead, and the stench was horrid; Those that remained had pitched their tents about 200 yards from them and were too weak to move away entirely, which they soon intended to do; they were in such a state of dispair and despondence that they could hardly converse with us, a few of them had gained strength to hunt which kept them alive. From what we could learn, three fifths had died under this disease...." (Tyrrell 1934:268-269 citing David Thompson's Narrative, pp. 321-322).

Devastating as the smallpox was, many Indians recovered, and many others were able to avoid it and carry on. When questioned by his superior about the extent of the epidemic the master at Hudson House replied, "...I cannot say but what there is a few living here Yet, and a great many that has not had the disorder, the Old Sky and his Son, has not had the Disorder, what Indians is Living is very hard to deal with, Mr. Tomison.... Some of the Indians that is recover'd, has got a great many Skins laid up, but they are far away...." (Rich, et al. 1952:288).

During the next few years fur traders built posts ever farther up the North Saskatchewan. One of these was a North West Company establishment known as Umfreville's Post (Morton 1973:454; Wallace 1954). It was situated near Frenchman Butte about 275 km northwest of the Sjovold site. Edward Umfreville spent four years (1784-1787) in charge of this post and was one of the first to attempt a general survey of Northern Plains Indians (Wallace 1954:91-105). He mentions seven groups and gives the following comments about their numbers and distributions:

(1) the Nehethawa [Cree] Indians, best known to Umfreville of all Indians, were numerous but thinly spread over an extensive country stretching to the coast of Hudson Bay.

(2) the Assinnepoetuc [Assiniboine] Indians, a tribe anciently detached from the Naudawissees [Sioux] on the Mississippi River, were pretty numerous and were scattered over a great extent of country. They had always been in a strict alliance with the Nehethawa.

(3) the Fall Indians, thus named by the Nehethawa from their inhabiting a country of the south branch of the river, but known by the French as Gros Ventres, were not very numerous. Umphreville believed that they were detached from a distant nation. They were not initiated into the preparation of finer pelteries and brought only wolf skins. Umfreville had no interpreter for their language and communicated with them in Blackfoot. His word lists have been used since 1836 as evidence that the Fall Indians, at least the ones he encountered, were Algonkian-speaking Atsina (Gallatin 1836:126, 132).

(4) the Sussee [Sarcee] were very few in number, living near the Stony Mountain, speaking a language which no others could learn. They were recently at peace with the Bloods, but still attacked them. They retained close alliance with the Nehethawas for protection.

(5) the Blackfeet, (6) Paegan and (7) Blood tribes were all one nation speaking one language. They were the most numerous and powerful nation in Umfreville's acquaintance. They were very friendly and hospitable to fur traders.

The Snake Indians were enemy to all these Indians. Umfreville knew little about the Snakes, but thought that they lived west of the Rocky Mountains.

While Umfreville was on the North Saskatchewan other traders began to push up the South Branch and in 1786 built several posts known as the South Branch Houses (Morton 1973:337-338). These were located about 170 km northeast of the Sjovold site. David Thompson worked at the Hudson's Bay Company's South Branch House and later commented that the Indians who traded there were mainly Nahathaways and Stone Indians, also known as Assine poetwak or people of stoney lands. According to Thompson the two tribes appeared to be equally numerous (Hopwood 1971:87). The Crees had a long-standing hostility with the Fall Indians. During the summer of 1793, a large contingent of Crees, armed with guns from South Branch and Swan River houses, fell upon a band of Fall Indians camped in the Moose Woods about 45 km northeast of the Sjovold site. The Crees butchered all the Fall Indians in the camp except for a few children which they took as slaves (Morton

1973:456-457). Later that year, other Fall Indians took revenge by sacking Manchester House, a Hudson's Bay Company post on the North Saskatchewan. They wanted to obtain guns to better defend themselves against the Crees, and they wanted to punish the fur traders who had armed the Crees. Encouraged by success at Manchester House, Fall Indians attacked and sacked the Hudson's Bay Company's South Branch House in the spring of 1794. This caused the fur traders to abandon their South Branch posts for a few years.

However, in 1800 the Hudson's Bay Company's Peter Fidler was sent far up the South Branch to establish Chesterfield House for trade with the Fall, Blackfoot, Blood and Piegan Indians (Johnson 1967). Chesterfield House was located about 200 km west southwest of the Sjovold site. Fidler travelled up the South Branch seeing signs of former Indian encampments, but no Indians until after he had arrived at the site of his new post. He passed the Sjovold site on September 9 with little comment and arrived at the junction of the Red Deer and Bow rivers on September 25, 1800. His first Indian visitors were three young Fall Indians who were checking for his arrival. From then until December 1800 it was mostly Fall Indians who came to trade. Later, Blackfoot, Blood and Piegan also traded at the post in large numbers. There is a great deal of interesting information about Indians in Peter Fidler's journals and notes. Only a little of it will be noted here, in particular regarding the Fall Indians who were closest to the Sjovold site area.

On 17 February 1801, Fidler wrote that two Fall Indian young men had been killed and robbed by Blackfeet only one day's journey from Chesterfield House. However, those killings turned out to be the least of Fall Indian problems that year. When Fidler returned for a second season in September 1801 he began to hear about a string of calamities. He learned that during the summer Southern and Stone Indians had killed 76 Fall men, women and children in two different places, on the Moocoowans River near the Rocky Mountains and at the Iekimmecoo Hill [Cypress Hills]. Attackers had scalped three survivors whom they took for dead including two children about 10 years of age and a middle aged woman.

Even this was not the worst. During the Spring of 1801, Fall Indians had been infected with smallpox. Amazingly, the disease did not spread beyond their tribe. Fall chiefs told Fidler that it had carried off upwards of 100 of them that summer, all young people. They claimed to have received the smallpox from Tattooed Indians [Arapaho] who had come from far to the south. The Tattooed Indians were said to have caught it from Indians who had traded with Europeans far down the Missouri River. On October 31, Fidler actually saw the Tattooed Indians and recorded some information about their numbers and location:

> Three Tattooed Indian chiefs came with their families consisting of four young men, five women and seven children: this is a part of a nation that never saw Europeans before. They inhabit on the eastern borders of the mountain far to the south of this,

> they have been forty-four days in coming, they speak nearly the same language as the Fall Indians and are at peace with them, who have escorted them here. They brought a few beaver skins with them but very ill coloured and badly dressed, they are a pretty numerous tribe amounting to about 90 or 100 tents. Their manners are different from the Fall Indians, but are nearly of the same size and features (Johnson 1967:298).

This suggests that the Fall with whom Fidler was dealing were Atsina. Fidler went on to observe that "the Fall Indians, on account of the war and disease this summer cutting off such numbers of them, appears desperate, and is nearly ready to fall on anyone they can" (Johnson 1967:294). In February 1802, four Canadians brought 14 Iroquois Indians up the South Branch to Chesterfield House with the intention of doing some Beaver trapping in the Cypress Hills. They gave presents to the Fall Indians to gain their friendship, but the Fall were in no mood for friendship and killed all the Iroquois and two of the Canadians only a short distance from Chesterfield House. On February 21, 1802, seventy well-armed Fall Indians broke into the XY Company post adjoining Fidler's House and had to be driven out. The next day when they tried to get into his post, Fidler would not allow them past the gate. He explained that they:

> ...make us very fair promises and plenty of them, that we have not the least to dread from them, but we cannot sincerely trust them. This is the same people that plundered Manchester House in 1793 of every article, and who attacked the South Branch House in the spring following, and murdered every man woman and child at it, took everything of goods, which was considerable, and burnt the house to ashes. One of the New Company traders told Mr Wills in a private manner that the intentions of A Kas Kin, the chief of the nation, was not well inclined towards us on account of the death of his brother who was shot at the South Branch House by the Canadians at the same time that they destroyed ours. He was carrying fire to set fire to the house when he was shot; when he fell they all desisted and went away crying (Johnson 1967:316).

In the spring of 1802, Fidler was told by Blackfeet that "every Fall Indian with their families are pitched away for the Mis sis su rie River, and there to meet the Crow Mountain and Tattooed Indians and make a very formidable party, and that they will then come to fall upon us and proceed down the country to find the Crees and Stone Indians and kill what they can of them in revenge of last summer" (Johnson 1967:321). Since he did not return to Chesterfield House, Fidler never had to face that challenge.

It turned out that Indians of the Cree/Assiniboine and Fall/Blackfeet alliances were worn down by warfare and tried to make peace in 1803. Daniel Harmon, a fur trader at Fort Alexandria on the Assiniboine River, caught word of the peace-making process when he heard that 40 lodges of Crees and Assiniboines who had set off the year previous were returning home to Fort Alexandria from the Battle River, and that the other half of their party had separated at the Battle River, "...to go and make peace with their Enemies, the Rapid [Fall] & Black Feet Indians, for both parties begin to be weary of such a bloody War as has for such a length of time been kept up between them, and are therefore much inclined to patch up a Peace on almost any terms whatever" (Lamb 1957:6). Although Harmon appears to have had little personal familiarity with Fall Indians he had gained the idea that they, the Rapid Indians as he called them, were a tribe who remained "a considerable distance out into the large Plains and near the upper part of the Missisours River" (Lamb 1957:48).

In 1805, Harmon was sent to a new South Branch House, about 10 km upstream from the old ones. He commented that Crees, Assiniboines, Sauteux [Ojibwas] and Muskagoes [Swampy Crees] traded at the new house, along with a few Blackfeet now and then (Lamb 1957:97). Aside from the Sauteux and Muskagoes, this assortment sounds similar to that encountered by David Thompson 15 years earlier. On April 19, 1806, Harmon, still at South Branch House, noted that "The greater part of our Indians have gone to wage War upon the Rapid Indians, their inveterate enemies — with whom they often patch up a Peace, but it is never of a long duration" (Lamb 1957:99). But on April 28, he heard that the Rapid Indians had turned the tables. A small war party had killed several Assiniboine Indians camped within 25 km of South Branch House. During the attack the Rapid Indians stabbed and scalped an old woman who, nevertheless, survived and appeared to be recovering from her wounds. Harmon remained for the summer of 1806 at South Branch House, and on August 8, six Assiniboines arrived. They told him that about 160 lodges of Crees, Assiniboines and Blackfeet had been on their way to war against the Rapid Indians when a dispute broke out over a horse. This led to a battle in which 25 Blackfeet and three Assiniboines were killed. Harmon notes that the unexpected fight put an end to those Indians' war plans for the rest of the season. Here it is interesting to see Blackfeet, Cree and Assiniboines in alliance against Fall Indians.

Meanwhile, another trader, John McDonald of Garth, had gone up the South Branch to Chesterfield House to trade during the fall of 1804 (Masson 1890:28-34). En route his group encountered a war party of Crees somewhere north of the South Branch Houses and McDonald made clandestine arrangements with their leader to meet at the Moose Woods the following spring to trade furs. McDonald and his party continued on to Chesterfield House, passing the Sjovold site without comment. During the winter they traded mainly with Blackfeet, although a group of Missouri Indians tried unsuccessfully to fight their way in to trade with McDonald. During the return trip down the South Branch in the spring of 1805, McDonald stopped his brigade a certain distance above the Moose Woods, at or near the Sjovold site, and told them to stay there several days to hunt buffalo while he went on ahead. McDonald continued down to Moose Woods and did his trading, but while his men were stopped they were attacked by Missouri Indians and five were killed. That same summer other fur traders visited the Gros Ventres [Hidatsa] villages on the south side of the Missouri River and were surprised to see so many trade articles in their possession (Wood and Thiessen 1985a:166-169, 1985b:242-243). It turned out that these were the same Indians who had attacked McDonald's party that spring. Their numerous trade articles were booty from the attack.

During September 1808, Alexander Henry, a North West Company fur trader famous for extensive observations about life in the western interior (Coues 1897; Gough 1988, 1992), took up a new assignment at Fort Vermillion on the North Saskatchewan River (320 km northwest of the Sjovold site). Among his observations is an extensive commentary on the various native tribes he encountered at Fort Vermillion. The following names, numbers and distributional information are extracted from his work (Gough 1992:367-394).

(1) The Crees or Kinistineaux were a numerous people derived from the same stock as the Ojeebois or Saulteaux and inhabiting the country immediately adjacent and northwest of them as far as Peace River. Venereal disease was common among them and a common cause of death. Smallpox had made great havoc among them some years ago, but they were increasing in numbers very fast. They were dispersed over a vast extent of country and were frequently intermixed with Assiniboines and others so that it was difficult to estimate their population. Henry estimated a total of 300 tents capable of furnishing 900 warriors, exclusive of Cree north of the Beaver River.

(2) The Assiniboines or Stone Indians originated from the Sciex or Nadouasis to the Southward. They were a numerous people inhabiting a vast extent of Plains Country from the Hair Hills near the Red River, west along the Assiniboine River, from that to the junction of the North and South branches of the Saskatchewan River and along the Saskatchewan to Fort Vermillion, thence due south to the Battle River, then southeast to the Missouri, down that river to near the Mandan villages and then northeast back to the Hair Hills. Henry found that the Assiniboines were highly divided and named 11 regional subdivisions with a total of 850 tents exclusive of the Swampy Ground Assiniboines who had been reduced by smallpox to about 30 tents. The ones closest to the Sjovold site would have been: (a) 160 tents of Canoe Assiniboines living west of the Qu'Appelle Lakes, and (b) 50 tents of Saskatchewan Assiniboines who inhabited the South Branch and the Eagle Hills.

(3) The Blackfeet, Blood and Piegans were considered under the one grand appellation of Slave Indians. Their lands commenced at Fort Vermillion and ran due south to the South Saskatchewan River, followed up that stream to the Rocky Mountains, then north along the Rocky Mountains to the North Branch, and east back to Fort Vermillion. The Painted Feather band of Blackfeet were the most eastward, next to them were the Cold Band of Blackfeet, then the Bloods. The Piegans dwelt along the foot of the mountains. As to numbers, Henry's tallies were 120 tents for the Painted Feather Band, 80 for the Cold Band, 100 for the Bloods, and 350 for the Piegans. He commented that smallpox had destroyed great numbers of them, but that they were still very numerous and increasing fast.

(4) The Big Bellies or Rapid Indians were stationed to the south of the Slave Indians between the South Branch and the Missouri. Henry claims that they formerly occupied the point [tract] of land between the North and South Saskatchewan rivers, and he supposes that they got their name from rapids on those rivers. He also says that they are of the same nation as the Big Bellies of the Missouri

River. He estimates their numbers at 80 tents capable of fielding 240 men bearing arms.

(5) The Sarcees were a distinct nation with a language resembling that of the Chipewyans. They formerly dwelt on the north side of the Saskatchewan River but had moved south of the Beaver Hills where they lived near the Slave Indians. In 1809, they had 90 tents and 150 men capable of bearing arms.

Shortly after Henry's survey of Canadian Plains Indians, other fur traders began to make more general and systematic observations about Indians in their districts. At Fort Carlton on the North Saskatchewan River (160 km north of the Sjovold site), John Peter Pruden noted in his 1815 report that his district extended from Stinking Lake in the North to the elbow of the South Saskatchewan in the south and from Jack Lake in the west to Nut Hills in the east. The Indians who traded at Carlton House consisted of two nations, the Southward or Cree Indians amounting to 100 tents, and the Stone Indians with about 300 tents (HBCo B.26/e/1:fos.2-3).

In 1823, Francis Heron wrote a report for the Chesterfield House District (HBCo B.34/e/1) in which he says that four tribes — the Blood, Muddy River, Blackfeet and Fall Indians — supplied the principal trade. These four, he says, were collectively known as Slave Indians. The first three spoke the same language, but the Fall Indians spoke a language peculiar to themselves and to the Flying Fall Indians or Big Bellies. According to Heron, the Blood tribe amounted to 400 tents, the Muddy River tribe to 600 tents, the Blackfoot tribe to 600 tents and the Fall Indians also to 600 tents. As to distributions, he offered the following:

> As I have already observed that the Slave Indians are through necessity obliged to follow the movements of the Buffaloe, it will therefore be readily conceived that those tribes can have no fixed hunting grounds. There are, however, certain portions of the country considered by each tribe as their lands, and which they resort to when circumstances admit. The Blackfeet claim as their territories the country lying between the North and South Branches of the Saskatchewan, next the Stone Indians. The Blood Indians lay claim to the Country westward of the Blackfeet between the Bow & Fighting Rivers; and the Muddy River, and Fall Indians in general possess all that extensive country which lies between the Bow River and the Northern Branches of the Missouri (HBCo B.34/e/1:201).

Hostilities among Cree, Assiniboine, Fall and Blackfoot Indians in the region surrounding the Sjovold site continued almost unabated after the brief peace of 1803. The Carlton House report for 1818-1819 records several encounters: (1) Fall Indians killed one Stone Indian boy and wounded another at Bloodberry Hill about 135 km north of the Sjovold site; (2) a war party killed three Crees on the South Branch about 80 km south of Carlton House at or near the present City of Saskatoon; and (3) Blackfeet attacked 'Carlton" Indians at two other places killing 20 Assiniboine men and boys and wounding three Crees at a cost of five Blackfeet lives (HBCo B.27/e/2). A little more than twenty years later, when Sir George Simpson was passing through the Minichinas Hills (about 150 km north northeast of the Sjovold site) on his way to Fort Carlton, he heard a story about warfare which had taken place there about 1820. This story may even refer to the encounters listed in the Carlton House report for 1818-1819. In any case, the story is a particularly apt example of the vagaries of Northern Plains warfare.

> About twenty years ago, a large encampment of Gros Ventres and Blackfeet had been formed in this neighbourhood for the purpose of hunting during the summer. Growing tired, however, of so peaceful and ignoble an occupation, the younger warriors of the allied tribes determined to make an incursion into the territories of the Assiniboines. Having gone through all the requisite enchantments, they left behind them only the old men, with the women and children. After a successful campaign, they turned their steps homeward in triumph, loaded with scalps and other spoils; and on reaching the top of the ridge that overlooked the camp of the infirm and defenceless of their band, they notified their approach in the proud-swelling tones of their song of victory. Every lodge, however, was as still and silent as the grave; and at length, singing still more loudly, as they advanced, in order to conceal their emotions, they found the full tale of the mangled corpses of their parents and sisters, of their wives and children. In a word, the Assiniboines had been there to take their revenge (Simpson 1847:81).

Two years later, in 1821, the warfare was getting worse and all the Indians at Carlton House were said to have gone to Red River to mass with their allies and to plot war on the Slave Indians. A group of 40 tents of Cree coming from Fort Edmonton was too late to join the rest. They attempted to camp in the Eagle Hills, but two of their hunters were slightly wounded by the arrows of a ten man Blackfoot scouting party and so the whole band retreated to Fort Carlton and from there into the thickwoods to the north (HBCo B.27/e/3). A few years after that, during July of 1826, some 80 tents of Fort Carlton Crees were attacked at the Moose Woods by a war party of Blackfoot, Blood, Sarcee and Fall Indians. Eleven of the Crees were killed and many more were wounded. The survivors fled half-naked into the woods and suffered great privation until, in weakened condition, they made their way to Fort Carlton and received assistance from the traders. Meanwhile, the attackers carried off 77 tents and other property belonging to the Crees (HBCo B.27/e/4).

Documents pertaining to the central South Branch region from 1826 to 1857 are rare. This decline in documentation coincides with: (1) a period of fur trade monopoly by the Hudson's Bay Company; (2) a great reduction in the number of Company posts and servants following the union of 1821; (3) a shift in fur trade exploration toward the far north; and (4) the long tenure of Sir George Simpson as Governor of the Company. Fortunately, Simpson himself recorded some useful observations during his world tour of 1841-1842 (Simpson 1847; Dempsey 1990), a trip which carried him across the top of the Northern Plains. He noted that Fort Carlton was visited by Saulteaux, Crees and Assiniboines in great numbers and that Blackfeet had made hostile forays into that country, but not in recent years. He crossed to the north side of the Saskatchewan River at Carlton and resumed his overland journey to the northwest saying that "We are now in the hunting ground of the Crees, probably the largest tribe in the country" (Simpson 1847:86). It is interesting to note that he places the heart of the Cree territory north of the Saskatchewan River. On the other hand, it is puzzling that he calls them the largest tribe, since this generalization is contradicted by his own population estimates a few pages later. The key word may be country.

Table 1.3. Simpson's Population Estimates for the Saskatchewan District in 1841.

Tribe	Tents	People
Crees	500	3,500
Assiniboines	580	4,060
Blackfeet	300	2,100
Piegans	350	2,450
Blood Indians	250	1,750
Sarcees	50	350
Gros Ventres	300	2,100
Saulteaux	20	140
Half-breeds	40	280
Totals	2,390	16,730

Simpson (1847:86-88) included a brief synopsis of western Cree history to 1841. Referring to an earlier account by Alexander Mackenzie (Lamb 1970), Simpson says that during the late 1700s Crees swept northwestward to the borders of the Arctic Circle and beyond the Rocky Mountains chiefly due to their possession of European fire-arms. Soon, however, their advance was checked by epidemics of measles and smallpox which found their way northward from the Missouri River country and which killed a large portion of the Crees while exempting the more northern tribes. Then, as the northern tribes began to acquire guns, the western Crees themselves came under attack. At that point, "the Crees, branching off into a variety of bands, gradually advanced towards the south, no longer confining themselves as hunters to the thickwood countries, but scouring the open prairies on horseback" (Simpson 1847:87). During 1818-1819, thousands of Cree were said to have been carried off by a second visitation of measles, however, Simpson thought that their numbers had grown steadily afterwards and that by 1841 they had once again recovered their strength of the late 1700s. He described their 1841 boundaries as extending from the Assiniboine River on the south to Lake Athabaska in the north.

When he arrived at Fort Pitt (290 km northwest of the Sjovold site), Sir George commented that the post was frequented by Crees, Assiniboines and Blackfeet. Eleven lodges of Crees were at Fort Pitt to greet their arrival and one of them contained a warrior who had been severely wounded by a Blackfoot musket ball. "These Crees, like all those that we had previously met with, were keeping out of the way of the Blackfeet" (Simpson 1847:95).

Simpson continued on to Fort Edmonton where he wrote an ethnographic sketch of the Blackfoot tribes (Dempsey 1990) and assembled population estimates for each of the tribes in Saskatchewan District, an area roughly coincident with the Canadian prairies exclusive of the Red River settlement (Simpson 1847:102; see also Table 1.3). Simpson noted that his estimates reflected substantial reductions due to the great smallpox epidemic of 1837 and other causes such as warfare (Dempsey 1990). He guessed that as many as half of the Plain tribes population could have died in the 1837 smallpox epidemic (see Ray 1974:182-194 for more information about demographic changes during that period). The reduction seemed most extreme for the Sarcee. He estimated their pre-1837 population at 140 tents and 1800 souls. Simpson's claim to have undertaken mass vaccinations during the 1837 epidemic is fascinating. He says that as soon as he learned about the smallpox he sent vaccines and instructions to interior districts of the Hudson's Bay Company to vaccinate all Indian camps within reach. As a consequence, "nearly the whole population of the thickwood country were saved from the ravages of that fatal malady" (Dempsey 1990:4). Such an unbalanced tragedy must have given the woodland tribes an advantage over Plains tribes in their, by then, deeply entrenched mutual antipathies.

Sir George offered only vague definitions of Blackfeet territories: "the hunting grounds of these Indians is confined to the Plains lying contiguous to the East side of the Mountains." He adds that the Cree hunting grounds "adjoin...separated only by the Saskatchewan River." He did, however, supply an extended description of Blackfoot warfare saying that they were constantly at war with adjoining tribes, especially the Cree. Blackfoot war parties ranged very far afield, westward beyond the mountains in Flathead and Kootonais country, southward of the Missouri to the Mississippi Valley and up the Saskatchewan Valley to Cumberland House. In return the Blackfeet were attacked in their own country by enemies. According to Simpson, Crees alone killed no fewer than 900 Blackfeet during 1824 (Dempsey 1990:8). Thus, warfare imposed another oppressive type of population control on Northern Plains Indians during the 1820s to 1840s.

Nelson (1973:97-99) has been able to discern some historical trends for the 1830-1860 period in the Cypress Hills area, trends which are probably also valid for the Sjovold site area. He suggests, for example, that between 1830 and 1860 tribes such as the Blackfeet traded more at American posts on the Upper Missouri River than at Hudson's Bay Company posts. As a result, the territories of these tribes tended to shift southward. During the same period the Gros Ventres seem to have disappeared from their old haunts along the South Saskatchewan River and to have occupied a more restricted zone in the Upper Missouri region. Although Nelson does not say so, the Assiniboines could also be included in this southward shift as indicated by their absence at Fort Qu'Appelle in the 1860s, a place which had once been an important part of their territory. By the 1860s, the Fort Qu'Appelle trade was mainly with Plains Cree and Saulteaux, although an outpost was also created for trade with the Assiniboines at Wood Mountain some 240 km to the southwest (Cowie 1913:205, 241, 247, 302-303).

There were several factors involved in these shifts. For one thing, transportation advantages brought about by the introduction of Missouri River steamers permitted American traders to offer cheaper trade goods than were available at Hudson's Bay posts. In addition, increasing use of Cree and Metis buffalo hunters as Hudson's Bay Company provisioners meant that the territories of Canadian Plains tribes were squeezed to the west and south, ever farther from the Hudson's Bay Company provisioning posts. By the 1840s, the Red River and Assiniboine River Metis numbered more than 5000. By the 1850s, their annual hunts were killing thousands of bison and were extending into the Yellowstone River Valley on the southeast and up to the foothills of the Rocky Mountains between the Saskatchewan rivers on the west. By 1853, the Plains tribes were complaining that their hunting grounds were being encroached upon by Red River Metis to such an extent that they were finding it difficult to kill enough animals to survive (Nelson 1973:99).

During the late 1850s, the governments of Canada and Great Britain each sent an official exploring party to Western Canada. First to arrive, in 1857, was Britain's Captain Palliser. His route carried him up the Qu'Appelle River Valley to the elbow of the South Saskatchewan River where he commented: "We are now in the heart of the buffalo country. This region may be called a buffalo preserve, being the battle-ground between the Crees and the Blackfeet, where none go to hunt for fear of meeting enemies and where those who go to war abstain from hunting" (Spry 1968:146).

In a later version of the journal, Palliser modified this statement by saying it was "the neutral ground of the Crees, Assineboines, and Blackfeet" (Spry 1968:145-146). Palliser wanted to travel upstream from the elbow to old Chesterfield House, but his men were alarmed at the danger of proceeding further into Blackfoot country and convinced him to cross the river only a short distance upstream from the elbow. Then, they turned northward for an overland trip to Fort Carlton. They passed by the Sjovold site and went all the way to Carlton without sighting any Indians, although they did see an old pound in the vicinity of the Moose Woods. Neither did they see many buffalo, most of the ground having recently been burned by prairie fires. Among the members of the Palliser expedition was Dr. James Hector who later contributed to a general treatise on prairie Indians north of the 49th parallel. The following summaries are abstracted from Hector and Vaux (1861).

(1) Thickwood Crees of the Saskatchewan district inhabited a belt of country west of Lake Winnipeg and stretching along the northern border of the prairies as far west as 113° [Edmonton]. They were most numerous near Fort Pelly and Fort à la Corne, but also traded at forts Ellice, Carlton,

Pitt and Edmonton. They lived mainly in the woods, but occasionally made autumn excursions into the plains for buffalo.

(2) Prairie Crees favoured the Qu'Appelle River Valley for summer camps. That valley was also the northern border for the Assiniboine and Sioux. Prairie Crees sometimes pitched west to the elbow of the South Saskatchewan and thence to the Neutral Hills, Beaver Hills and Fort Edmonton. They could be found along the Battle River south of Fort Pitt, in the Bad and Eagle Hills, between the two branches of the Saskatchewan River and, during winter, along the North Saskatchewan at Carlton or in the Touchwood Hills north of the Qu'Appelle. Hector and Vaux say that they travelled in companies of 200 to 400 tents, hunted buffalo for the Hudson's Bay Company to the point of depleting the herds in their area, and numbered about 12,500 souls. They thought that the population was decreasing due to smallpox and other diseases.

(3) Plain Stoneys or Assiniboines had once been very powerful inhabitants of the Saskatchewan district between Fort Carlton and the Missouri Coteau. However, smallpox seemed to have singled them out for more severe visitation than any other prairie tribe leaving them almost extirpated in the northern part of their country. That country was then occupied by Crees. They still dwelt along the International Boundary line south of Fort Ellice and west to the Cypress Hills where they remained a fairly numerous tribe. The one band which Hector encountered had about 1000 souls.

(4) Rocky Mountain and Thickwood Stoneys lived in the Rocky Mountains and the thickwoods east of the Rocky Mountains, near Rocky Mountain House, Bow River Fort and Pidgeon Lake Mission. Those in the forest were a small tribe of scarcely more than 100 tents or 500 souls. They belonged to the same tribe as inhabited the country northwest of Lake St. Anne's and along the Athabaska River. Those in the Rocky Mountains were more numerous. They travelled in parties of six or seven families hunting moose, deer and Rocky Mountain sheep.

(5) Slave Indians comprised the balance of the prairie tribes seen by Hector. In general they roamed the prairies along the South Saskatchewan and Red Deer rivers during summer while retiring to the northwest to tent along the edge of the woods between Rocky Mountain House and Bow Fort in the winter. The Slave Indians consisted of the Blackfoot tribes — Blackfeet, Bloods and Piegans — and the Surcees. Their only food was the buffalo and they tended to go hungry rather than eat small game. "According to their own notions, it would be better for them if we would leave them alone; as their only fear for the future is caused by their perceiving the rapid decrease in the numbers of buffalo, owing to the active trade forced on them for robes and provisions" (Hector and Vaux 1861:258). Hector and Vaux claimed that they had not suffered much from smallpox, but did suffer a great deal from an obscure and usually fatal disease involving collapse and a "low typhoidal state" (ibid.). They traded chiefly with Americans; although the Blackfeet proper also traded a good deal at Rocky Mountain House where they found the goods superior to those available at American Forts. The

Blackfoot tribes had a portion of their territory south of the boundary line and received a share of subsidies granted by the American government in accordance with the Indian treaty. They were constantly at war with the Crees, Assiniboines or Crow Indians.

Surcees, the other component of the Slave Indian grouping, were a branch of the great "Chippewayan family" who had broken away from their relatives in the woods far to the north and had changed their habits to those of the prairie Indians (Hector and Vaux 1861:256). They had summer camps in the Hand Hills, wintered near the elbow of the Battle River, sometimes in large camps with the Blackfeet, but usually by themselves. They traded at Fort Edmonton. Hector and Vaux observed that goitre, which was rare among other Indians, was almost universal among the Surcees. They provide no estimates for the numbers of Slave Indians, and make no mention of Fall Indians.

The year after Palliser's Expedition passed through the Sjovold site area, a second government exploring party led by Henry Yule Hind came along a similar route. As the Hind expedition moved westward along the upper part of the Qu'Appelle River Valley toward the elbow of the South Saskatchewan River during the summer of 1858, it seemed once again that the primary inhabitants were Plains Cree (Hind 1971:338-347, 354-65). In a camp near a buffalo pound Hind met Plains Cree elders and talked for six or seven hours about various subjects. One topic drew particularly heated comment.

> All speakers objected strongly to the half-breeds' hunting buffalo during the winter in the Plain Cree country. They had no objection to trade with them or with white people, but they insisted that all strangers should purchase dried meat or pemmican, and not hunt for themselves.
>
> They urged strong objections against the Hudson's Bay Company encroaching upon the prairies and driving away the buffalo. They would be glad to see them establish as many posts as they chose on the edge of the prairie country, but they did not like to see the prairies and plains invaded (Hind 1971:360).

As Hind's party neared the elbow of the South Branch they were warned by the Crees to be careful. A war party of Blackfeet was said to be in the neighbourhood watching for an opportunity to steal horses and, if possible, "lift a scalp" (Hind 1971:I, 365). This warning fit rather well with earlier information Hind (1971:II, 28-29) had received to the effect that the elbow area contained one of five celebrated war-paths in the western interior:

> The selection of certain tracts of country for the "War-path" is probably determined by the facilities presented for communication and concealment combined. The following are celebrated "war-paths," where hunting is generally disallowed, although game from that circumstance is usually most abundant.... 4. The "War-road," near the elbow of

> the South Branch of the Saskatchewan, on the flanks of the Grand Coteau, of the Blackfeet and Plains Crees.

Other information about Blackfoot whereabouts came from Mis-tick-oos, a chief of the Crees, who said he had received a black stone pipe as a gift from a Blackfoot chief at the Eagle Hills some three weeks earlier (Hind 1971:I, 361). When Hind reached the elbow of the South Saskatchewan River he and three others embarked in a canoe to drift downstream while the rest his party followed with the carts and horses along the east bank. On the morning of July 31, 1858, when Hind had drifted about 12 miles below the elbow, three Crees called to him from the east bank to say that they were "pitching eastward" to avoid the Blackfeet (Hind 1971:I, 383). Later on the same day about 30 miles below the elbow, in the vicinity of the Sjovold site, Hind came upon 19 tents of Crees who had just crossed the river, but he drifted several miles further downstream in order to avoid them (Hind 1971:I, 384). For the purposes of our study it is a great pity that he failed to stop. From that point to the junction with the North Branch Hind saw no people and very little game.

The last record we will consider is that of the Earl of Southesk, a wealthy adventurer (Southesk 1969). The Earl came up the Qu'Appelle to the elbow of the South Branch in the summer of 1859 and decided to follow the east bank downstream while hunting bison and looking for a crossing place. The crossing he found was, he estimated, between 20 and 30 miles downstream from the elbow. Indeed, the Sjovold site is 29.5 miles downstream and we are suspicious that that is where he crossed. Southesk's description of the crossing locale is frustratingly vague. However, it appears to have been a regular native crossing place, because he found recent tents rings on the west side and a trail leading off to the west. The best fit for the land marks and distances he mentions would be a trail connecting the Sjovold site to the north end of Lake Milden and thence to Macdonald Creek. Because of the probability that his crossing was within the Sjovold site locality, we quote Southesk's observations at some length.

While speaking about the width of the South Saskatchewan at the elbow and downstream Southesk (1969:76-77) says, "My own party crossed at a place between twenty and thirty miles below the elbow, and there I estimated the breadth at 600 yards, the river being considerably in flood." Then he continues:

> *July* 12*th*.— We left the Elbow soon after breakfast, and travelled northwards down the course of the stream, keeping as near it as the many ravines permitted. Our object was to discover a suitable crossing place, in order to follow the buffalo herd, but it was no easy matter to find one, such facilities being rare in that part of the Saskatchewan, owing to the general steepness and muddiness of the descent to the water's edge (ibid.:79).
>
> [On the east bank at the crossing place, July 13th]: Two or three flat sandy islands just

> showed their heads above the rush of the stream. The banks at that part were comparatively low, and sloped gradually from the prairie till within some fifty feet of the water, when a steep pitch intervened.
>
> The whole place abounded with the berries we had been feasting on during the last week. 'They grow on a willow-like bush, and taste like geans or wild cherries, but sweeter. In size they resemble common white currents, and are of a purple colour. M'Kay calls them Shad (?Shade) berries; the Indian name is Meesasskootoom-meena.'
>
> All this evening we were busy with preparations for crossing the river. 'The men worked at frames for two flat-bottomed canoes. They placed six stakes in the ground to mark out the shape, and round these (which they afterwards removed) they made an open frame of light wood, with ribs still lighter. The whole was tied together with bark or leather thongs, then an oil-cloth was stretched over [and securely fastened at the gunwale.] The Indians use prepared skins to cover the outside' (ibid.:86-87 [line drawings of the canoe frame in top and side views are provided on p.88]).
>
> *July* 14*th*.— 'The river crossed this afternoon'...
>
> We began by unloading the carts, after which the men pushed and pulled them through the shallows to a half-dry flat, in ordinary times a long projecting spit of sand but now a sort of island, a good way distant from the bank of the river. Thence they were passed to the other side on the oil-skin scows, which also took all the baggage across in several separate transits. For my own part, I was quickly and easily ferried over by Toma and Matheson, in an unladen boat.
>
> Indians, we discovered, had recently availed themselves of this very crossing-place. Close at hand we came upon the recent traces of an extensive camp. I picked up among the tent-sites a piece of hard grey stone, not unlike a coarse sort of agate, also a broken bit of ore, both of which seemed to have been used for some particular purpose. Fragments of marble and red agate were scattered here and there on the river-banks. Wild strawberries, in full ripeness, grew plentifully near our encampment. Small and deficient in flavour, though pleasant to the taste, they much resembled the variety so common in the woodlands of Europe.
>
> *July* 15*th*.— We continued our march in a westerly direction, and after some twelve miles over a country of dried-up swamps and sandhills, we arrived at a brackish lake about five miles long and of a similar breadth. Its name, if it had one, was unknown, this road being little frequented; even Nummé had never travelled by the line we were following, though he had been in hunting expeditions in the neighbouring country...
>
> After dinner we marched some ten miles farther till we came to a branch of Eagle Creek (So at least Nummé termed it, but I have my doubts as to his accuracy in this and other similar instances), where we halted, as the stream was deep and miry, and more than twenty yards across (ibid.:89-90).

Milden Lake is 14 miles west of the Sjovold site and is 5 miles long, although only 0.5 miles across. Macdonald Creek is an additional 9 miles to the west.

Summary of Historic Observations

Four tribes seem to have been primary occupants of the study region during the historic period: Assiniboines, Crees, Gros Ventres, and Blackfeet. Snakes, a generic term for enemies who were not members of the predominant tribes, often raided into the area but did not make it their home. In attempting to plot territorial boundaries of the predominant tribes one immediately encounters two problems, namely, inadequacies in the requisite historical information and inherent weakness in the territorial boundaries between bison-hunting peoples (HBCo B.34/e/1). No land was used exclusively by any one tribe; all lands were subject to friendly or war-like incursions by neighbours and distant strangers. Incursions could occur at almost any time. Nevertheless, in spite of the tenuous nature of Northern Plains territoriality, it seems that certain districts tended to be occupied predominantly by one or another tribe. Moreover, it appears that this territoriality could be sustained over long periods, extending into centuries.

Our interpretation of territorial boundaries for the four predominant groups is divided into two phases, 1690-1837 and 1837-1860 (Fig. 1.3). The point of division is the smallpox epidemic of 1837. During 1837, Assiniboines, Gros Ventres and Blackfeet bore the full brunt of the epidemic's effects and lost substantial portions of their populations. However, people at the edges of the woodlands, particularly Crees and Metis, were spared through a last minute vaccination program by the Hudson's Bay Company. Although a variety of other pressures influenced Indian numbers and distributions before and after 1837, the uneven effects of this particular epidemic tipped a fairly long-standing cultural balance. Thereafter, territorial boundaries showed some dramatic changes as depleted Assiniboine, Gros Ventres and Blackfeet populations withdrew to the south and west, and Crees, Metis and Saulteaux moved into the vacated territories.

According to our information, the Sjovold site remained near the confluence of several tribal boundaries even through some historical shifts. We might predict, therefore, that the locality was highly susceptible to incursion. Furthermore, the South Saskatchewan River does not seem to have served as a territorial boundary or as a particularly protective barrier. Thus, if we were trying to ascribe ethnic affiliations to material cultures or to detect prehistoric/historic continuities and discontinuities, the Sjovold site would be a poor place to start. Rather, we should be wary that people of many different tribes could have occupied the site at any particular time.

Another interesting point is the great distances Plains bison hunters were capable of travelling. One example is Henry Kelsey's Assiniboine guides. They brought Kelsey from York Factory about 1000 km inland to east-central Saskatchewan on their return from a trading trip. Another case is provided by the Archithinue natives whom Anthony Hendry visited in south-central Alberta in October 1754. Seven months later they intercepted him about 560 km down the South Saskatchewan River in order to trade with Hendry's party before they left the Plains country. A third example is the Missouri

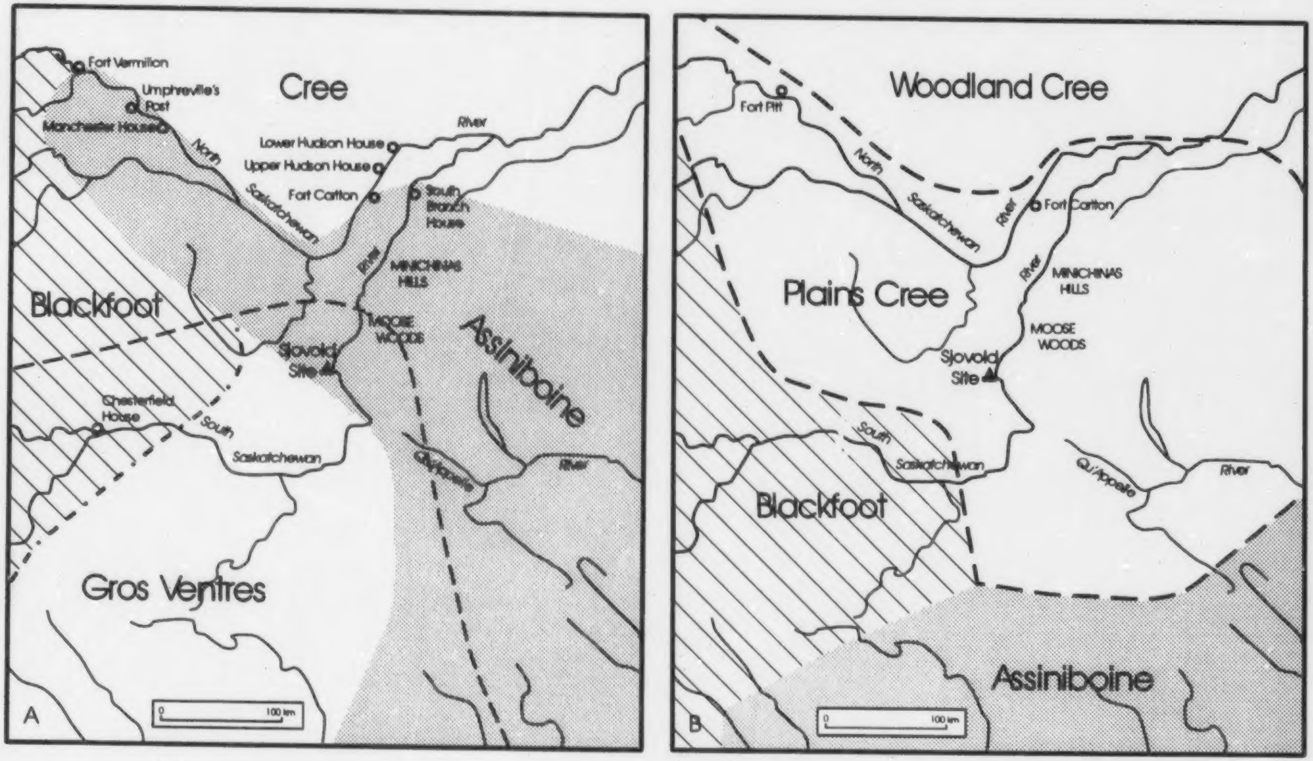

Fort Vermilion
Umphreville's Post
Manchester House
Cree
North
Lower Hudson House
Upper Hudson House
Fort Carlton
Saskatchewan
River
South Branch House
MINICHINAS HILLS
MOOSE WOODS
Blackfoot
Sjovold Site
Assiniboine
Chesterfield House
South
Saskatchewan
Qu'Appelle
River
Gros Ventres
0
100 km
A
Woodland Cree
Fort Pitt
North
Saskatchewan
River
Fort Carlton
MINICHINAS HILLS
MOOSE WOODS
Plains Cree
Sjovold Site
South
Saskatchewan
Qu'Appelle
River
Blackfoot
Assiniboine
0
100 km
B

Figure 1.3. Historic distributions of Indian nations in the region surrounding the Sjovold site: A. AD 1690-1837; B. AD 1837-1860.

Indians who, in 1805, travelled from the Knife River region of the Missouri River to Chesterfield House to trade with John McDonald of Garth. When that failed they travelled down the South Saskatchewan River approximately to the Sjovold site where they found, attacked and looted McDonald's outbound brigade. Then, they returned to the Missouri River laden with booty having made a round trip of at least 1500 km. These examples show that very extensive travel was a common part of Northern Plains life. It should not be surprising, therefore, to find exotic materials in the Sjovold site as a reflection of such travels in prehistoric times.

With respect to population sizes, there are two points to be made. First is that population densities were small throughout the historic period, probably running in the order of 20,000 to 30,000 people for the whole Canadian Plains (see also Wissler 1936, 1939). This works out to a population density of 0.05 to 0.07 people per square kilometer, a very sparse population which had a great many camping options. Consequently, frequent reuse of a particular site should be an indication that special resources or advantages existed in that locality. Secondly, the observed range in the size of campsite populations is amazingly broad extending from a few tents containing three to 30 people to gigantic camps consisting of hundreds of tents and thousands of people. Given this rather large range it would be foolhardy to predict how many tents might be expected for any particular Sjovold site occupation.

A final point concerns observed native uses of the Sjovold locality. There are two observations which seem particularly relevant, and both refer to Indian encampments at a river crossing about 30 miles downstream from the elbow of the South Branch. Since the Sjovold site is 29.5 miles below the elbow and seems well suited for a river crossing place, it could be the place to which the observations apply. Hind's 1858 note is least useful as it refers only to 19 tents of Indians who had just crossed the river. He does not say on which side they were camped. The Earl of Southesk's observations, made the following year at approximately the same place, is a little more helpful. He talks about recent traces of an extensive camp on the west side of the river. One wonders whether this might have been the group Hind saw the previous year. In addition, Southesk writes about a little-used road leading from the crossing toward the west. By his subsequent description it seems that the trail probably led to the north end of Lake Milden and thence to McDonald Creek. The best overall geographic fit for Southesk's vague directions and distances would be with a river crossing at the Sjovold site or very nearby. If the Sjovold locality was an ancient river crossing, as we now suspect, then that would be a special feature which could account for the unusually long record of repeated use revealed by our excavations.

Chapter 2

Regional Archaeology

The Central South Branch Region

The following summary provides an overview of the archaeological setting for Sjovold site investigations. Our focus is on a circle of land some 200 km in diameter with the Sjovold site at its center, an area which can be referred to as the Central South Branch Region (CSBR). The review covers investigations up to 1993, some 14 years past the time when Sjovold excavations were initiated. During those 14 years the amount of archaeological information about the CSBR has almost doubled.

Over the past hundred years thousands of archaeological sites have been exposed accidentally by ongoing cultural and natural processes in the CSBR. Innumerable surface collections of artifacts have been made from these exposures by a wide spectrum of people. In addition, many aboriginal constructions such as graves and stone cairns have been deliberately opened and looted. Unfortunately, most of the resulting artifacts and observations are undocumented, although useful information is still recoverable in some cases (Dyck 1984; Conaty, et al. 1988). The earliest published record for the CSBR was made by a paleontologist, William Parks (1925). Together with a local medical doctor, J.J. Finn, Parks excavated a half bushel of broken bones and teeth, along with shell, bone and tooth beads and pendants, chipped stone arrowheads, other chipped stone tools, chipping debris, a bone whistle or flute, a dolomite pestle, and another pounding or grinding stone — all from a bog about 64 km northeast of the Sjovold site (for continuing studies of the Finn bog site, ElNo-3, see McCann 1982, 1983, 1985, 1986).

The beginning of systematic archaeology in the CSBR dates to the "dust bowl" years and the 1935 formation of the Saskatoon Archaeological Society (Caldwell 1988; Jones, et al. 1988; Spinks 1988). Members of the Saskatoon Society laid a good deal of archaeological groundwork by exploring the local landscape and discovering dozens, if not hundreds, of archaeological sites. Gradually, they were able identify common and unusual tool types, materials, features and sites (e.g. Cronk 1956, 1958; Edmunds, et al. 1938; Kupsch, et al. 1970; Phenix 1966; Vigfusson 1940). They learned how to replicate stone tools (Jones, et al. 1988:16), joined the search for "early man" on the prairies, and became strong advocates of archaeological record-making (e.g. Sewell 1944). At the same time, the southern part of the province was under exploration by members of an early version of the Saskatchewan Archaeological Society (Robinson 1944, 1949; Watson 1977b) as well as the Saskatchewan Museum of Natural History (Dyck 1987).

The first general survey of southern Saskatchewan was undertaken by Boyd Wettlaufer (1951) under the auspices of the National Museum of Canada and the Saskatchewan Museum of Natural History. Wettlaufer made the first archaeological site records for the Sjovold vicinity during this survey. In 1954, the University of Saskatchewan and the Saskatchewan Research Council established the first radiocarbon dating laboratory in Western Canada at Saskatoon (Rutherford and Wittenberg 1983). That same year the new laboratory contributed dates to the Mortlach site investigations, thus initiating a radiocarbon-based chronology for the northern Plains (Wettlaufer 1955). During the 1950s the Saskatchewan Museum also got involved in site studies which led to publication of two important multicomponent site reports (Wettlaufer 1955; Wettlaufer and Mayer-Oakes 1960) and some important single component site reports (Nero and McCorquodale 1958; Kehoe and McCorquodale 1961a, 1961b). In 1963, the current Saskatchewan Archaeological Society was convened (Johnson 1987). In 1964, the University of Saskatchewan established a Department of Anthropology and Archaeology which also became deeply involved in the advancement of local archaeology (Pohorecky 1987). This was followed by the development of archaeological capabilities at the University of Regina in 1970.

The cumulative programs and publications of the archaeological societies, national and provincial museums, and the two universities have created a broad and durable record of prehistoric artifact types, functions and ranges of variation for the southern part of the province. A combination of these efforts provided the foundation for the first detailed chronology of archaeological assemblages in Saskatchewan (Wettlaufer 1955; Wettlaufer and Mayer-Oakes 1960). Based on stratigraphy and radiocarbon dates, the chronology covered the last 5000 years of the archaeological record. Most of the information was generated outside the CSBR. Nevertheless, the results were soon seen to be broadly applicable across southern Saskatchewan.

The first major project within the CSBR was the South Saskatchewan River Survey of 1958-60 (Pohorecky 1959, 1960, 1961; Bennett 1960). It was undertaken in order to locate and salvage archaeological materials threatened by construction of Gardiner Dam, just 24 km upstream (southeast) from the Sjovold site, and by inundation of the Lake Diefenbaker Reservoir extending 135 km upstream from the dam. During three field seasons archaeological field parties explored the dam site plus a little more than half of the reservoir. They located about 200 new archaeological sites. These were mainly surface scatters of stone and bone, but also included tipi rings, human burials, buried occupation layers; an immense glacial erratic thought to be at the center of a ceremonial site; a suspected clay quarry, a petrified wood quarry, buffalo and Indian trails; the Ghost Coulee massacre site where 600 Blackfeet are reputed to have died in 1866; a boulder monument consisting of a 23 m diameter circle of stones with a central cairn and an outlying cairn; a turtle petroglyph on a granite boulder; a suspected bison kill site, and so forth (Pohorecky 1961). Test excavations at the mouth of Coteau Creek revealed a buried Besant occupation layer. A series of tests and surface collections at sites on the opposite side of the river, along Aitkow Creek, revealed a 4000 year sequence of components extending from McKean Lanceolate, through Late Prehistoric, and into early historic abor-

Table 2.1. Archaeological complexes studied in the Central South Branch Region.

AGE Complex or Series	References
LATE PLEISTOCENE	
Clovis	Pettipas (1975)
EARLY HOLOCENE	
Folsom/Midland/Plainview	Conaty, et al. (1988), Cronk (1958), Kehoe (1966a), Pettipas (1975), Pohorecky (1960, 1961), Watson (1977a)
Agate Basin/Hell Gap	Conaty, et al. (1988), Johnson (1975b), Pettipas (1975), Pohorecky (1960, 1961)
Firstview/Alberta/Scottsbluff	Conaty, et al. (1988), Dyck (1969), Johnson (1975b), Pettipas (1981)
Frederick/Lusk/Brown's Valley/Jimmy Allen	Johnson (1975b), Phenix (1966)
MIDDLE HOLOCENE	
Mummy Cave Series	Conaty, et al. (1988), Johnson (1975b), Walker (1988a, 1992), Zurburg (1991)
Oxbow Complex	Amundson (1986), Conaty, et al. (1988), Dyck (1970, 1972b, 1977), Foster (1972), Johnson (1975b), Linnamae (1982a, 1983, 1989), Millar (1978, 1981), Walker (1983a, 1988b)
McKean/Duncan/Hanna Series	Conaty, et al. (1988), Johnson (1975a, 1975b), Pohorecky (1960, 1961), Linnamae (1989), Ramsay (1993), Watson (1973), Walker (1983a, 1984, 1988b)
LATE HOLOCENE	
Pelican Lake Series	Clarke and Meyer (1993), Conaty, et al. (1988), Kelly (1986), Johnson (1975b), Pohorecky (1960, 1961), Linnamae (1989)
Besant Series	Conaty, et al. (1988), Dyck (1972a), Kelly (1986), Johnson (1975b, 1988), Phenix (1969), (Pohorecky 1960, 1961), Ramsay (1991), Walker (1983a, 1988b)
Avonlea Complex	Clarke and Meyer (1993), Conaty, et al. (1988), Dyck (1972b), Kelly (1986), Walker (1983a, 1988b)
Prairie Side-notched Series	Clarke and Meyer (1993), Conaty, et al. (1988), Dyck (1972b), Johnson (1975b), Jones (1985), Pohorecky (1960, 1961), Linnamae (1989), Meyer and Clarke (1991), Prentice (1983), Walker (1979, 1983a, 1988b)
Plains Side-notched Series	Conaty, et al. (1988), Kelly (1986), Johnson (1975b), Pohorecky (1960, 1961), Linnamae (1989), Walker (1983a, 1988b)
Moose Jaw Complex and Wascana Ware ceramics	Malainey (1991)
Mortlach Ceramics	Malainey (1991), Clarke and Meyer (1993), Rollans and McKeand (1992)

Table 2.1 (continued).

AGE Complex or Series	References
Undifferentiated Late Side-notched or ceramic	Amundson (1986), Millenium Heritage Resource Consultants Ltd. (1988), Pohorecky (1960, 1961), Walker (1983a, 1988b)
Historic Indian	Clarke and Meyer (1993), Pohorecky (1960, 1961, 1970), Walker (1983a, 1988b)

iginal occupations. Meanwhile, test excavations conducted at the mouth of Swift Current Creek, near a Plainview point discovery, produced a multicomponent site but no diagnostic artifacts. The project investigators had begun to formulate hypotheses about site distributions and other questions. Unfortunately, the study was aborted in 1961 (Dyck 1987:26; Spurling 1987:65-66).

As data and interpretations accumulated, increasingly complex prehistories of southern Saskatchewan were written (A. Kehoe 1962; T. Kehoe 1963, 1966a, 1966b, 1974; Kehoe and Kehoe 1968; Pohorecky 1970, 1973; Hanna 1970; Jones 1980; Dyck 1983; Meyer and Epp 1990; Bryan 1991; Dyck and Morlan n.d.). The culture-historical scheme used here is that of Dyck and Morlan (n.d), itself a revision of Dyck (1983). Two of the classificatory units which find frequent use in later chapters of this book are the terms, "complex" and "series." An archaeological complex is a large grouping of sites, features and artifacts that shares similarities in content, style, technology, patterns of associations, geographical distribution and temporal range. The equivalent human grouping is not precisely known, but may be something in the nature of a long-lived regional association of bands. A complex is an archaeological unit of high integrity, one for which the several important aspects are fairly well known. Not all archaeological entities, however, are so well known. The term "series" provides a temporary classificatory unit for an archaeological grouping whose existence has been demonstrated, but whose various aspects are poorly known. A series may contain one or more archaeological complexes. The label emphasizes a suspicion that perceived ambiguity reflects a sequent set of complexes. An alternate term, little used here, is "aggregate". An aggregrate is a temporary grouping of what may be one or more complexes that are suspected to be roughly contemporaneous.

Many studies with limited geographic or topical focus have also been undertaken. Those which are specific to the Central South Branch Region are summarized in Tables 2.1 and 2.2. The tables reveal that all complexes known for the Canadian Plains, from Clovis to historic Indian, are represented in the CSBR. Germann, Richards, Krozer, Minto and Suterland (Germann 1989) carried out the first general assessment of archaeology in the Central South Branch Region as part of a heritage resource planning study of a larger cross-cutting area. Their South Saskatchewan River Basin study area has the same core as our CSBR. Germann and his coauthors counted a total of 1976 pre-

Table 2.2. Archaeological localities studied in the Central South Branch Region.

Locality	References
Elbow of the North Branch	Hanna and Russell (1983)
Dunfermline Sand Hills	Dyck (1970, 1972a, 1972b, 1977), Davidson (1975), Jones (1985), Prentice (1983), Walker (1979)
Saskatoon area	Amundson (1986), Brace (1977, 1978, 1987), Clarke and Meyer (1993), Cronk (1958), Edmunds, et al. (1938), Germann (1989), Hedger (1968), Kelly (1986), Kehoe (1966a), Kupsch, et al. (1970), Linnamae (1982b), Meyer and Clarke (1991), Millenium Heritage Resource Consultants Ltd. (1988), Pohorecky (1960, 1961, 1970), Ramsay (1993), Rollans and McKeand (1992), Sewell (1944), Walker (1983a, 1983b, 1983c, 1988a, 1988b, 1992), Wettlaufer (1951), Zurburg (1991)
Bear Hills	Conaty, et al. (1988), Farrell (1986, 1989), Gibson (1978), Gilchrist, et al. (1989, 1990), McFarlane and Tosh (1988), Richards (1987b), Wettlaufer (1951)
Moose Woods/Pike Lake Sand Hills	Dyck (1970, 1971), Germann (1989), McCann (1982, 1983, 1985, 1986), Linnamae (1989), Parks (1925), Walker (1984), Wettlaufer (1951)
Allan Hills	Conaty, et al. (1988), Germann and Thomas (1985), Linnamae (1982a, 1983)
Bad Hills	Brace (1987), Conaty, et al. (1988), Ferland (1992), Houston (1988), Pettipas (1975, 1981), Richards (1987a)
Harris Sand Hills	Douglas (1986), Epp (1983, 1986), Epp and Pendree (1978), Pendree (1981, 1982), Wettlaufer (1951)
Outlook District	Fidler (1966), Germann (1989), Johnson (1975a), Wettlaufer (1951)
Coteau Hills	Conaty, et al. (1988), Dyck (1969), Germann (1989), Pohorecky (1959, 1960, 1961)
Elbow of the South Branch	Conaty, et al. (1988), Germann (1989), Johnson (1975b, 1975c, 1976, 1988, 1991, 1992, 1994), Johnson and Johnson (1977, 1978), McCann (1987), Phenix (1969), Pohorecky (1959, 1960, 1961, 1965, 1966, 1970), Ramsay (1991), Stevenson (1992, 1993a, 1993b, 1994a, 1994b), Watson (1974, 1977a), Wettlaufer (1951)
Vermilion Hills	Germann (1989), Pohorecky (1960, 1961), Richards, et al. (1987)
Saskatchewan Landing area	Bennett (1960), Epp (1972), Foster (1972), Germann (1989), Millar (1978, 1981, 1985), Millar, et al. (1972), Millenium Heritage Resource Consultants Ltd. (1986), Pettipas (1975), Phenix (1966), Pohorecky (1959, 1960, 1961, 1984), Watson (1973), Wettlaufer (1951), Wilson (1972, 1977)

Table 2.3. Archaeological components in the South Saskatchewan River Valley by complex and degree of Investigation.[a]

Period	Complex or Point Type	Known Components	Excavated Components
Early	Clovis	4	0
	Folsom	8	0
	Agate Basin	13	1
	Hell Gap	2	0
	Cody Complex	21	0
	Late Paleo-Indian	3	0
	Suspected Paleo-Indian	19	0
Middle	Mummy Cave Series	13	3
	Oxbow Complex	143	4
	McKean Series	119	1
	Pelican Lake Series	149	3
	Unidentified	24	?
Late	Besant Series	177	11
	Avonlea Complex	40	6
	Prairie Side-notched	90	5
	Plains Side-notched	83	8
	Unidentified	126	?
Unidentified Prehistoric		942	?

a. based on Germann (1989:53-56).

historic archaeological components (from 1474 sites) in their 49,000 km^2 study area using the provincial site inventory as a source. They noted that the inventory had been assembled mainly within the past thirty years, that it was far from complete, and that it was based on a mixture of observations, including: (1) fortuitous discoveries and reports by landowners; (2) more purposeful surveys in areas of high surface visibility by amateur archaeologists; (3) a few professional surveys in which systematic sub-surface testing was rarely used as a method for site discovery; (4) attempts at recording amateur collections; and (5) a few substantial excavation projects. The general lack of sub-surface exploration takes on added significance when one considers that only 51% of the land surface has been disturbed by agricultural and urban development. To our knowledge, a substantial portion of disturbed lands, though probably less than half, has been searched and collected, and much of what has been found has been recorded or remainsavailable for consultation in private collections. The 49% balance of mainly undisturbed (and unexplored) lands in the region is under pasture and forest (Germann 1989:12-13).

Table 2.4. Dated archaeological components in the Central South Branch Region.[a]

AGE Complex, Series or Point Type	Site	Dated Components	Number of Dates
MIDDLE HOLOCENE			
Mummy Cave Series	FaNq-25, Gowen 1	1	5
	FaNq-32, Gowen 2	1	5
	FaNq-56, Norby	1	3
Oxbow Complex	EcNx-1a, Gray Burials	?	17
	EcNx-4, East Pasture	1	1
	FaNq-5, Moon Lake	1	1
	FbNp-17, Amisk	2	2
	FbNs-1, Harder	1	5
	FbNs-3, Carruthers	1	1
McKean/Duncan/Hanna Series	EkNv-36, Billet (Hanna)	1	2
	FaNq-30, Graham (Duncan)	1	1
	FbNp-10, Red Tail (Hanna)	3	3
	FbNp-10, Red Tail (McKean)	3	3
LATE HOLOCENE			
Pelican Lake Series	EkNv-26, Wallace Adair	1	1
	ElNo-36, Cline	1	1
Besant Series	EgNn-1, Melhagen	?	6
	FaNp-7, Rocky Island	1	1
	FaNr-2, Grandora	1	1
	FbNp-1, Tipperary Creek	1	1
	FbNp-16, Newo Asiniak	2	2
Avonlea Complex	EgNr-2, Camp Rayner	1	1
	FaNp-19, Hartley	1	1
	FbNp-1, Tipperary Creek	2	2
	FbNp-16, Newo Asiniak	1	1
	FbNs-2, Rousell	1	1
	FbNs-15, Goosen Pasture	1	1
Prairie Side-notched	FbNp-16, Newo Asiniak	1	1
	FbNr-1, Tschetter	1	3
Plains Side-notched	EcNx-4, East Pasture	1	1
	FbNp-1, Tipperary Creek	4	4
Undifferentiated Late Side-notched	FbNp-1, Tipperary Creek	5	5
	FbNp-17, Amisk	1	3

Table 2.4 (continued).

AGE Complex, Series or Point Type	Site	Dated Components	Number of Dates
Mortlach Aggregate	FaNp-9, Bill Richards	1	1
Historic/Protohistoric Indian	FbNp-1, Tipperary Creek	1	1
Unidentified	EcNx-2, Heron	?	2
	EcNx-4, East Pasture	1	1
	EgNr-2, Camp Rayner	1	1
	EiNr-2, Carroll Burial	1	1
	EkNm-1, Bradwell Burial	1	1
	EkNv-36, Billet	1	1
	ElNq-36, Beaver Creek	1	1
	ElNs-4, Zoerb	1	1
	FaNr-2, Grandora	1	1
	FbNp-10, Red Tail	1	1
	FbNp-16, Newo Asiniak	2?	2
	FbNp-16, Newo Asiniak	3	3
	FbNp-17, Amisk	4	4
Totals		67?	110

a. data from Morlan (1993a).

Germann and his colleagues subdivided their compilation into 70 components belonging to the Early Period (11,500-7,700 BP), 448 belonging to a Middle Period (7,700-1,850 BP, defined to include Pelican Lake), 516 to a Late Period (2,000-170 BP) defined to exclude Pelican Lake), and 942 being of unknown age or affiliation. Table 2.3 contains a further breakdown of the same components according to cultural identity, number, and whether or not the components have been excavated (Germann 1989:55-56). Early Period components are known only from disturbed surface contexts with one possible exception, a debateable Agate Basin component at EgNr-2. For the Middle Period, Oxbow, McKean and Pelican Lake components are almost equally numerous. Nevertheless, the extent of Oxbow excavations at places like the Gray Burial Site, the Moon Lake, Harder and Amisk sites makes that complex the best known. Next best known of Middle Period components, in our opinion, is the Mummy Cave series, due to excavations at the Gowen and Norby sites. For the Late Period, Besant components are the most extensively investigated with notable exposures at the Melhagen, Coteau Creek and Grandora sites. Prairie Side-notched is next best known primarily due to extensive excavations at the Tschetter bison pound. Stone circles and cairns are the most common prehistoric features in South Saskatchewan River Basin sites, followed by hearths, burials, and other surface stone configurations such as medicine wheels, effigies and petroglyphs (Germann 1989:60).

Chronology in the CSBR is based on a combination of borrowed chronology from adjoining regions, radiocarbon dates on components in the CSBR, and stratified multicomponent sites in the CSBR. The chronology used here is that of Dyck and Morlan (n.d.). Morlan (1993a) recently made a compilation of radiocarbon dates for Saskatchewan, including 305 archaeological dates from 231 components in 107 sites. Out of that total, 134 of the dates are from the CSBR, 24 of them being from the Sjovold site. The 110 dates outside the Sjovold site are from 67 components in 31 sites. These may be subdivided according to cultural association as shown in Table 2.4.

Several points arise from the compilation of CSBR radiocarbon dates. First is the observation that there are no Pleistocene or Early Period dates. This reflects our failure, so far, to discover undisturbed cultural components belonging to those periods. However, in view of the number of Early period projectile points found in disturbed contexts within the region (Table 2.1), it seems likely that undisturbed Early Period components will eventually be found. A second point is that dating of Middle and Late Period complexes is quite well advanced. All Middle and Late complexes known for the Central South Branch Region have at least one dated component. The complex with the most robust combination of dates and dated components is, by a wide margin, the Oxbow complex. It has 27 dates from at least seven components (the Gray site may represent many components, but is counted here as one). Also well-dated are the McKean series (9 dates on 8 components), the Avonlea complex (7 dates on 7 components), and the Besant series (11 dates on 6 components). The remaining complexes can be described as moderately well-dated, specifically: the Mummy Cave series (13 dates on 3 components), Plains Side-notched components (5 dates on 5 components), Prairie Side-notched components (4 dates on 2 components), the Pelican Lake series (2 dates on 2 components), and a miscellaneous combination of late Late Prehistoric components (9 dates on 7 components). A substantial number of dated components from the CSBR are culturally unidentified. While these have indicator value for future research, they do not presently contribute to our chronology.

A point not evident in Table 2.4 is that our knowledge about the age of some complexes is much better than our knowledge of contents. In the CSBR this is particularly true for the McKean series, the Pelican Lake series, the Avonlea complex and the late side-notched complexes (with the possible exception of Prairie Side-notched). Often such disconformities in knowledge are due to practical problems such as the tendency for dates and identities to be known (and disseminated) early in the course of a research project, and for detailed description, analysis and interpretation of material remains to follow much later (as in the case of the Sjovold site). Another problem is sample size. For some dated components we have only a very small sample of cultural remains.

Brief mention must be made of the CSBR's rich endowment of stratified multicomponent sites. Almost 50% of the excavated components in this region are from such sites. Prior to excavation of the Sjovold site (with 20 occupation layers), the longest sequence was at the East Pasture site (with 3 layers). There were, however, a good number of sites with at least two components. Since 1980, several sites with longer sequences have been explored or are in the process of exploration (Tipperary Creek, 16+ layers; Red Tail, 15+ layers; Newo Asiniak, 7 layers; Amisk, 7 layers). Germann (1989:Table 9) contains an analysis of associations among various complexes in multicomponent sites. From the Middle Period on, all possible combinations are known except, apparently, Mummy Cave and Oxbow. However, in view of the obvious similarity between Mummy Cave series projectile points and Oxbow points at the Gowen sites (e.g. Walker 1992:Pl.24, l-n), even that exception may eventually disappear. It is reassuring that without exception multicomponent sites in the CSBR confirm the relative sequence of the regional chronology.

The Sjovold District

The Sjovold district, for purposes of this review, is coincident with the EiNs block of the Borden Uniform Site Designation System for Canada (Fig. 2.1). The block extends from 0.5 km north of Outlook to about 0.5 km north of Macrorie, a total of 17.5 km, and from about 5 km east of the South Saskatchewan River to about the same distance west. The Sjovold site is situated roughly at the center of the block.

Three archaeological sites were known here prior to our work. EiNs-1 is a site on the crest of a knoll about 2 km northwest of the Sjovold site. Standing on EiNs-1, one has a commanding view of the surrounding countryside in all directions, including the Bratton Channel a short distance to the south. The dominant feature at EiNs-1 is a large limestone erratic about 5.5 m in length with an above-surface height of 2.1 m. Glass trade beads, presumably left by historic Indians as offerings, have been found in the crevices of this rock by several persons. The site was reported to the Saskatchewan Museum of Natural History (SMNH) by J.G.S. McMorine, a P.F.R.A. Engineer, in 1949. Subsequently, Wettlaufer (1951:60, 63) included it as No. S-65 in his 1951 survey, and Pohorecky (1960) gave it the Borden number, EiNs-1, during the South Saskatchewan River survey some years later. We visited the rock on several occasions during our field research at the Sjovold site and talked to members of the Sjovold family about it as well. During these inquiries we recorded another instance of the discovery of beads in the erratic's crevices, and we added a few measurements and photographs to the site record. No detailed study of the rock or its immediate milieu has ever been made. A similar but larger rock, EgNo-19, used to be situated on the north side of Aiktow Creek some 60 km to the southeast (Pohorecky 1961:110-112, 1965, 1966, 1970:31-32).

A second site, EiNs-2, which used to contain to a large group of stone rings was also reported by J.G.S. McMorine in 1949. The rings were said to have been situated on a plateau on the south side of the Bratton channel about 1 km southwest of EiNs-1. The site was included by Wettlaufer (1951) as part of his No. S-65 but, later, SMNH staff gave the rings a separate designation. We visited the reported location of EiNs-2 during the summer of 1980. All that we saw during a cursory survey of

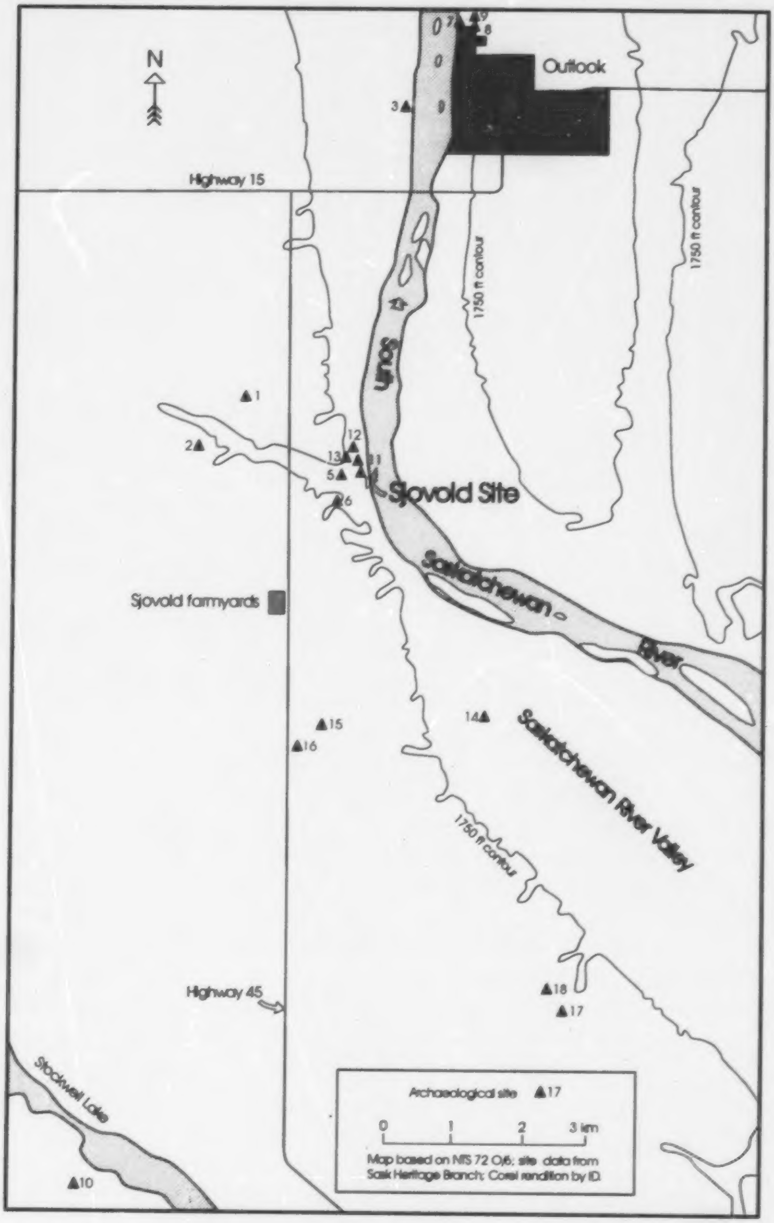

N
Outlook
Highway 15
1750 ft contour
1750 ft contour
South
Sjovold Site
Saskatchewan
River
Sjovold farmyards
Saskatchewan River Valley
1750 ft contour
Highway 45
Stockwell Lake
1
2
3
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Archaeological site ▲17
0 1 2 3 km
Map based on NTS 72 O/6; site data from Sask Heritage Branch; Corel rendition by ID.

Figure 2.1. Map of the EiNs block of the Borden Uniform Site Designation System.

the plateau was a single ring about 4.5 m in diameter. The ring consists of 21 stones and is near the southwest corner of the quarter section. Oscar Sjovold, who has lived just 2 km southeast of the site for about 70 years, told us that many of the EiNs-2 stone rings had been collected for use as "rip-rap" in a construction project along the South Saskatchewan River several decades before 1980.

A third site, EiNs-3, contains the remains of a buried hunter-gatherer occupation layer. It is situated on the west bank of the South Saskatchewan River directly opposite the Town of Outlook, about 5.5 km north of the Sjovold site. Very little is known about EiNs-3 except that it contains a layer of fire-broken rock, pulverized bones and pieces of chipping debris, petrified peat being a conspicuous part of the chipped stone remains. Deposits at the heart of the site have been removed in a "borrow pit" operation and used for construction of a weir in the river. The site's fringes remain undisturbed and are partly exposed in the walls of the borrow pit. Several slabs of unchipped petrified peat were seen within the pit. This lead us to the inference that natural deposits here are a source for that material, an inference that has recently been confirmed by the geological work of E.A. Christiansen (personal communication to Ian Dyck in July 1994). The site was reported to SMNH by Barbara Hamlin of Outlook and was inspected and recorded by Ian Dyck in October 1978.

EiNs-4 is the fourth site discovered in the Sjovold district. A detailed account of the history of its investigation is provided below.

Fourteen other sites and find spots have been recorded in the provincial inventory since the Sjovold work began. These include: a Boy Scouts' picnic and camp site (EiNs-5) covering much of the mouth of Bratton Channel but centered on a slump block about 100 m west of the Sjovold site; find spots of chipped stone debris and broken bones 100-200 m northwest and west of the Sjovold site (EiNs-11, 12 and 13); the cellars of a metis homestead (EiNs-6) on a ravine bank about 600 m southwest of the Sjovold site; a buried Late Prehistoric occupation layer (EiNs-7) and two findspots (EiNs-8, 9) near the northwest corner of Outlook; an artifact find spot (EiNs-14) on a river flat about 4 km southeast of the Sjovold site; two artifact scatters (EiNs-15, 16) on the slopes of the Missouri Coteau about 4 km south of the Sjovold site; a couple of artifact find spots (EiNs-17, 18) near a ravine on the brim of the river valley about 11 km southeast of the Sjovold site; and a small scatter of chipped stone debris (EiNs-10) near the south side of Stockwell Lake about 12 km southwest of the Sjovold site.

Oscar Sjovold has supplied us with additional observations on the district. He told us that the old Highway 45 right-of-way used to bend eastward through the mouth of the Bratton Channel within about 100 m of the Sjovold site. That brought numerous picnickers to the site area from the 1920s until the road was closed in 1962. It also gave local people easy access to the river for hauling water, and, before the traffic bridge was built at Outlook, it supplied access to a winter entry to the river. West of the creek mouth, before construction of modern Highway 45, Oscar recalled the existence of a couple of stone rings on the surface of a slump block about half way down the north bank of the Bratton Channel, a stone's throw east of the present Highway 45. These were destroyed by construction of the highway. He also mentioned finding a stone arrowhead in his own farmyard, and that his sons had found a number of arrowheads on drifting fields immediately south of their farmyard.

Overall, although the Sjovold district shows signs of considerable archaeological potential, the state of present knowledge, aside from that which we are about to present for the Sjovold site, must be judged as being scant.

In conclusion, previous archaeology in the Central South Branch region shows that:

1. The Sjovold district, with pronounced landscape features such as the South Saskatchewan River, the Bratton Channel, and a sand hills area on the east edge of the river, has good potential for a fairly dense concentration of sites containing aboriginal occupation remains. Prior to our investigations, recorded sites consisted of: one large glacial erratic with glass beads, presumably offerings, in its cracks; a large tipi ring camp; a couple of culturally unidentified buried occupation layers, several surface find spots of broken bone and stone chipping debris; and a Metis homestead site. Sjovold site investigations, therefore, constitute the first substantial archaeological study in the district.

2. The CSBR has been under increasingly systematic archaeological investigation for the past 68 years. A considerable body of archaeological observation has accumulated and indicates that the vast majority of archaeological remains known so far belong to the Middle and Late Prehistoric periods. Early Period remains are present, but only in very small quantities and in disturbed or mixed contexts.

3. The best known archaeological complexes and series are Oxbow, Besant, Mummy Cave and to a lesser degree, Prairie Side-notched. In other words, our best knowledge is of the Middle Period. Complexes and series which are equally abundant but less intensively studied are McKean, Pelican Lake, Avonlea, and late side-notched point and ceramic bearing complexes generally. These abundant but poorly studied complexes are an obvious target for additional research.

4. New information about almost any aspect of any complex would be welcome. For example, we would like to know more about regional sources of chipping stone, ancient differences in the landscape, assemblage inventories, site types, seasonality, complex distributions, game utilization, other subsistence activities, and the evolution of any complex from inception to demise. A shortcoming which severely handicaps our studies is an impoverished knowledge of campsite features. Campsites, of many different types, are likely to be the most common of archaeological sites in the region. A great many activities were carried out in such sites and our best hope for reconstructing those activities is through recognition and interpretation of features. Some commendable work has been done on tipi rings, hearths, cairns, post molds and artifact debris scatters, but, by and large, our conception of and

capacity to recognize, let alone interpret, campsite features is still extremely primitive. Features, therefore, are another obvious target for additional research.

The Sjovold Site: History, Objectives and Field Work

History of Investigations

During the summer of 1965, Ralph Sjovold and his brother, Leslie, spent a day exploring their father's pasture for archaeological remains. Near the mouth of a small creek on the west bank of the South Saskatchewan River they found a cutbank which contained buried lenses of charcoal and ash that they interpreted as hearths. On the slopes of the bank close to the hearths they found pieces of bone, rock and a side-notched chipped stone projectile point, all of which they knew to be signs of Indian occupation. Having located a promising site they went home for lunch and returned with shovels and a piece of combine sieve. About two meters north of the creek bank they excavated a rectangular pit roughly 75 cm wide by 135 cm long and 90 cm deep. Sifting the soil through their sieve they recovered numerous bits of bone, rock, chipped stone, pottery and another projectile point. They saved only the point and some of the pottery. At the end of the day the brothers finished the project by backfilling the pit so that their father's cattle would not injure themselves. That was the end of their explorations.

In 1976, Peter Farden of Davidson reported the site's existence to the archaeology section at the Saskatchewan Museum of Natural History (SMNH). Late in October 1976, Ian Brace visited the Sjovold farm in behalf of the SMNH, and Leslie Sjovold showed him the site but could not show him the artifacts. Ralph Sjovold had already taken them elsewhere. On 5 November 1976, Brace prepared a formal report of investigations for his supervisor, Ian Dyck, and filed a site record on the Sjovold site, EiNs-4, in the Museum's Archaeological Site Inventory. What seemed especially noteworthy was a possible association between pottery and crude side-notched point(s) which, from Leslie Sjovold's description, seemed to belong to the Besant series. Such an association was a matter for doubt among archaeologists at the time. Museum staff were interested, but were not then in a position to pursue the matter.

During 1977, Dyck and Brace visited the site and confirmed that at least three separate occupation zones existed within the upper meter of creek bank deposits. The deepest seemed to be densest. Preservation of bone was excellent; chipped stone debris was moderately abundant; occupation layers, though faint and sparse in some places, seemed to be separate from one another in a well-stratified sequence. The warm protected position of the grassy ridge on which the site rested with close access to water was noteworthy. Sjovold family members, particularly Oscar and Elvina Sjovold (see Fig. 2.2), were very hospitable and encouraged further investigations. They offered Museum personnel

Figure 2.2. Oscar (left) and Elvina Sjovold with Ian Dyck at Sjovold site excavations, July 1979. RSM #EiNs-4:79-001 CT.

free access to the site, permission to excavate, and permission to maintain a field camp on adjoining land. The only thing they could not supply was the artifacts recovered in 1965. Thus Dyck and Brace were unable to verify an association between Besant projectile points and pottery but did conclude that the site held considerable archaeological potential. Its situation in a region that was relatively unknown to archaeologists added to the priority for further investigation. Accordingly, Dyck made plans for test excavations as soon as the Museum's work schedule would allow it.

Museum staff were committed to other projects during the summers of 1977 and 1978, but by mid-summer of 1979 were able to undertake test excavations at the Sjovold site (Dyck 1979). The 1979 field staff consisted of Ian Dyck, Jean Prentice, Olga Klimko, Lawrence Melit, and Dianne Wilson-Meyer, assisted by volunteers Paul Dyck, Urve Linnamae, and David Meyer. Although initial plans were for three weeks of work, the site proved so interesting that field work was extended to six weeks. By that time it was clear that the remains discovered by the Sjovold brothers were part of a very small concentration which extended about 15 m east-west along the creek bank. The concentration lay at the center of a small ridge of sandy-silty sediment which projected into the creek mouth parallel to the South Saskatchewan River (Fig. 2.3). Posthole-augered tests over the adjoining habitable area on the ridge and its shoulders revealed widely scattered traces of prehistoric occupation up to 45 m

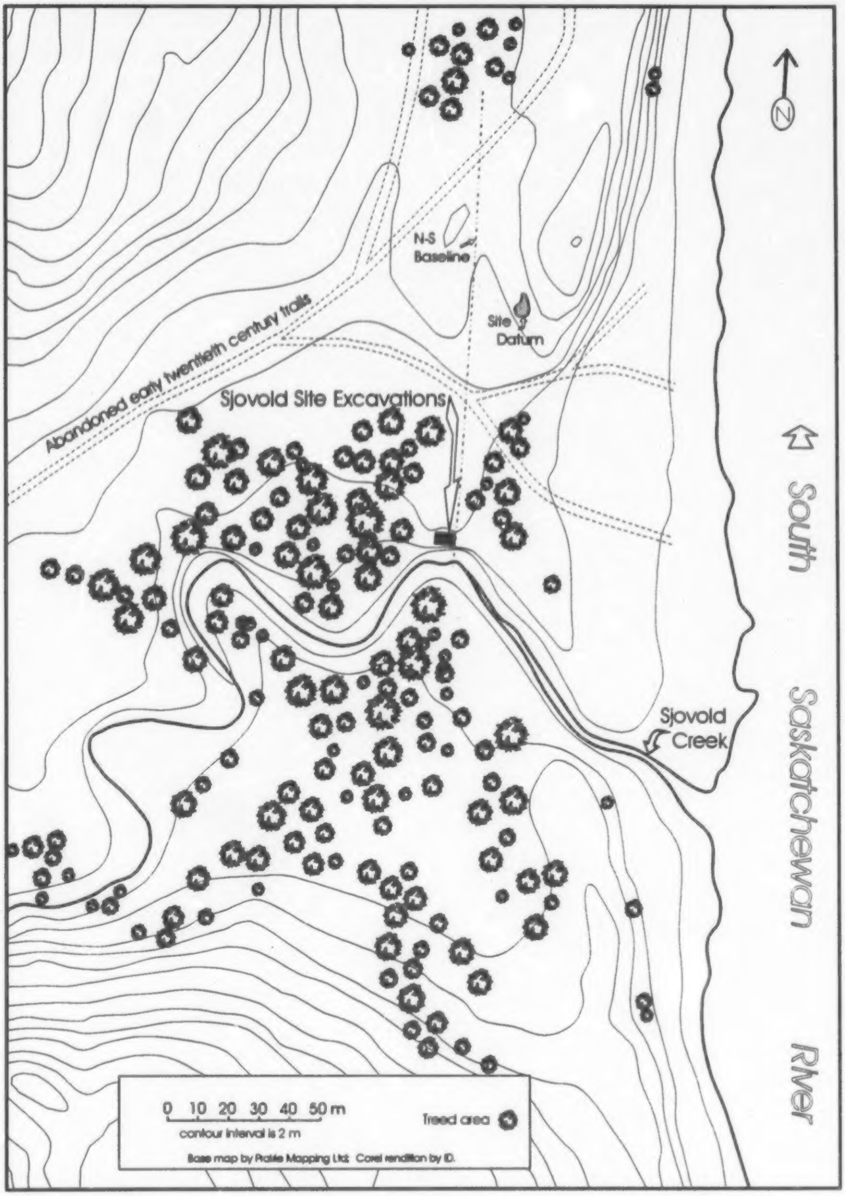

N
N-S Baseline
Site Datum
Abandoned early twentieth century trails
Sjovold Site Excavations
South Saskatchewan River
Sjovold Creek
0 10 20 30 40 50 m
contour interval is 2 m
Treed area
Base map by Prairie Mapping Ltd; Corel rendition by ID.

Figure 2.3. Contour map of the Sjovold site locality.

north of the creek. Land to the east and northeast dipped immediately into the bed of the South Saskatchewan River, and we did no testing there. Immediately south was the creek bed. On the south side of that is a slightly offset opposing ridge which pinches into the creek mouth from the south wall of the creek valley. The south ridge seemed a likely candidate for additional buried occupations.

However, exploration of the south ridge was secondary to our first priority, namely to learn more about the vertical extent and nature of remains on the north ridge. Accordingly, we cleared three vertical profiles along the top of the creek bank to a depth of about 2 m below surface. They revealed a minimum of 12 buried occupation levels. Our next step was to deepen one of the profiles to about 4.5 m. At about 4.5 m below surface the sandy silt deposits ended, and we found that they were underlain by a massive bed of gravel. It turned out that a total of 20 buried occupation horizons lay in the deposit extending to a little more than 4.2 m below surface. With this approximation of site structure in mind we laid out three contiguous 2 m by 2 m excavation units parallel to the creek bank and about 2 m to the north, and began controlled excavations. When time ran out the crew had completed 12 m^2 exposures of the top seven layers and had collected radiocarbon samples to date the whole sequence.

During the fall and winter of 1979-1980, Dianne Wilson-Meyer completed the artifact catalogue. Dyck submitted the radiocarbon samples for dating and received approval from the Director of the Museum, Dr. John E. Storer, for time and funds to complete test excavations to the bottom of layer 21 during 1980. Dr. E.A. Christiansen, a private consultant, agreed to provide a geological framework for the study and suggested other specialists who might assist with soil and sedimentary expertise.

The 1980 field season began on June 3rd and continued until October 1st (Dyck, et al. 1980). The 1980 staff included Ian Dyck, Jean Prentice, Lawrence Melit, Robert Phenix, Karen Elliott, Susan McIntyre, and Betty Helmond, along with volunteers Jos Dyck, Paul Dyck, Olga Klimko, Helen Klimko, and Peter Cason. The crew resumed excavation in the 1979 units and continued down to Layer X. At that level, for safety's sake, we stepped the excavations 2 m to the south before continuing down to the deepest occupation, Layer XXI. During the summer and fall of 1980, several consultants made observations in support of ancillary studies: Dr. Hugh E. Hendry of the University of Saskatchewan on sedimentology; Drs. Darwin W. Anderson and J.G. Ellis of the University of Saskatchewan on soils; Dr. Zoheir Abouguendia and others from the Saskatchewan Research Council on modern vegetation; representatives of Prairie Mapping Services on topography; and George Labelle of Cliffton Associates on engineering and safety. Some of the consulting reports were completed and put to use before the end of the field season. Others came later, the last being submitted in October 1982. Karen Elliott and Susan McIntyre of the Saskatchewan Museum of Natural History conducted a brief archaeological reconnaissance of the site vicinity, including the area near the creek mouth, during the summer of 1980. At the end of field season we moved all the artifacts and records to the

SMNH, Regina, for future analysis; Oscar Sjovold backfilled the excavation pit; Lawrence Melit catalogued the excavation photographs and slides and undertook an analysis of coarse rock from Layer X; Jean Prentice catalogued the 1980 artifacts and made an inventory of excavation records; and some additional radiocarbon samples were dated courtesy of the Archaeological Survey of Canada, National Museum of Man. Most of this post-excavation work was complete by August 1982.

In the fall of 1982, Dyck arranged for 3.5 months of relief from other Museum duties to begin analysis and writing of a Sjovold site report. He started the work in mid-December, but unforeseen circumstances intervened and the research had to be postponed (Dyck 1987). Artifacts and records were put into storage, and the project was shelved.

In November 1984, Dyck moved from the SMNH to the Archaeological Survey of Canada, National Museum of Man (now the Canadian Museum of Civilization [CMC]). During the spring of 1987, he borrowed the Sjovold site collection and records from the SMNH in the hope of pursuing analysis and report writing on a spare time basis. Gerald Conaty, Margaret Hanna, Lawrence Melit, and Ian Brace of the SMNH were instrumental in facilitating the loan. Robert Pammett and Ellen Foulkes took responsibility for unpacking and sorting the collection upon its arrival at the CMC. During the next two years Dorothée Jackson and Ian Dyck transcribed, collated and edited the field notes, and Dyck undertook some other minor sorting and analysis. Richard E. Morlan offered to analyze the faunal remains and to facilitate certain other studies. After October 1989, Dyck was able to devote a substantial amount of attention to the Sjovold site. From that time on he and Morlan collaborated in organizing, editing and designing the report. Dyck wrote the sections on historical setting, previous archaeological research, history of research, field investigations, cultural stratigraphy, layer by layer descriptions and interpretations of features, ceramics, stone tools, chipped stone debris, coarse rock, and overall interpretations of layer activities. Morlan took responsibility for the sections on environmental setting, radiocarbon dating, faunal analysis, and Appendix B, and he edited the contributed papers. Dyck and Morlan co-wrote the introduction, conclusions, and appendices A and C, and they edited each other's writing. Illustrations were prepared with the assistance of Deborah Brownrigg, David Laverie, and Ross Taylor. The Royal Saskatchewan Museum (formerly SMNH), Regina, is the permanent repository for the site collections and field records.

Research Objectives

Basic objectives for Sjovold site investigations were set out at the beginning of the 1979 field season:

(1) to undertake archaeological work in, at that time, a relatively unstudied portion of the province.

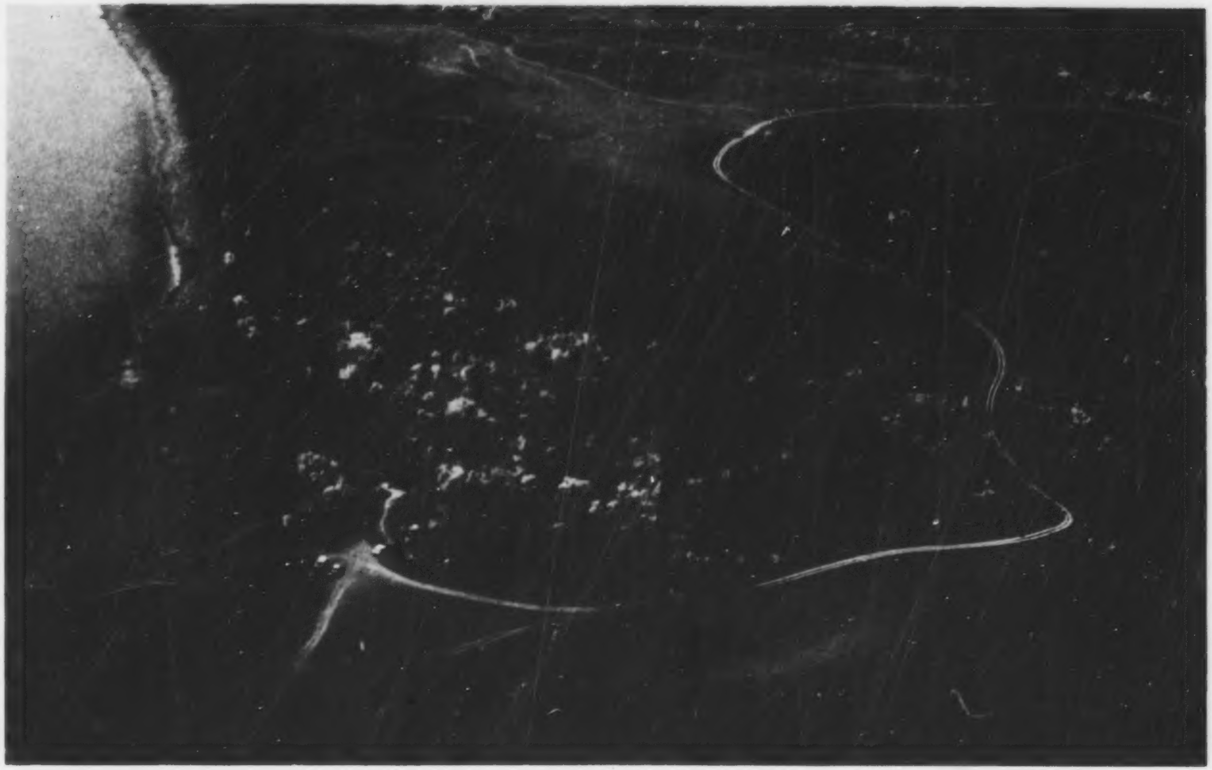


Figure 2.4. Oblique aerial view from the north showing the Sjovold site vicinity. Treeless areas were searched for surface artifacts in 1979-1980. RSM #EiNs-4:80-028 CT.

(2) to assess the structure and contents of the Sjovold site, specifically:
  a. the number of components and their stratigraphic positions.
  b. the kinds and quantities of remains preserved in each layer.
  c. the horizontal extent of all cultural layers within 1.25 m of present surface.

(3) to retrieve datable samples from each component.

(4) to establish the identity of what seemed to be the dominant cultural layer at the site, situated approximately 0.75 m below the modern surface, and to confirm or refute its possible association of Besant points and pottery.

(5) to obtain a sample of artifacts, features and distributional information for interpretation of cultural activities and identity of as many cultural horizons as possible.

(6) to make a preliminary assessment of the geologic processes which shaped the landscape at the site.

(7) to search adjoining river and creek valleys, as time and circumstances permitted, for surface evidence of prehistoric occupations which might add contextual information to Sjovold site interpretation(s).

Some of these objectives were realized by the 1979 investigations. We gained a good idea of the vertical extent of the site, a vague notion about the horizontal extent of near-surface occupations, and datable samples from many layers including the one at the bottom. We knew that Besant materials were absent from the upper layers and that the Sjovold site was far more complicated than we had expected. It was not just two or three layers within a meter of the surface. Instead, it contained at least 21 well-stratified occupation layers spanning more than 4 m of deposits. Though the upper layers did not contain Besant pottery, they did contain pottery belonging to later complexes. The upper layers also revealed an intriguing series of campsite features, an aspect of prairie prehistory which was very poorly known at that time and remains so today. We had collected substantial samples of artifacts along with feature and distributional information from the first seven layers, but we knew very little about the contents of the lower two-thirds of the site.

Throughout the fall and winter of 1979-1980, Dyck discussed the Sjovold site findings with other Saskatchewan archaeologists. Most considered the work to be a highly significant to northern Plains prehistory and urged him to continue. The Museum Director, Dr. John Storer, was also supportive. He promised funding for another field season, but offered a caution which Dyck already knew — that any commitment of Museum resources for analysis and writing had to be regarded as tentative since the Museum's future resources and priorities remained unpredictable (see Dyck 1987 for a history of archaeology in the Saskatchewan Museum of Natural History). Given the Director's support, and guessing that the timing was as propitious as it was ever likely to be, Dyck decided to complete the excavations during the 1980 field season. The objectives remained similar to those of 1979 with amplifications as follows:

(1) to complete the layer-by-layer exploration of site structure and contents to the bottom of the site.

(2) to describe the local landscape and reconstruct the paleoenvironment as far as research resources would permit.

(3) to prepare a comprehensive report on the findings of the Sjovold site project.

Field Methods

Archaeological investigations included: surface inspection of the site and its environs, excavation of test profiles, establishment of a site datum and reference grid, auger testing, and block excavations. The methods used for each aspect of the investigations are described below.

Surface Inspection. We made a brief walking inspection of all exposed surfaces west of the river within about 300 m of the site. This included bare portions of cutbanks along the creek and river, an abandoned road which ran through the creek and past the site, several cow paths leading to the river or creek, sparsely grassed slopes of creek valley walls to the north, northwest and southwest of the site, grassy portions of a large slump block within the creek bed about 75 m west of the site, and two grassy ridges pinching into the mouth of the creek parallel to and a few meters west of the South Saskatchewan River (see Fig. 2.4). This inspection yielded considerable evidence for historic and recent activities, consisting principally, according to members of the Sjovold family, of picnicking and (boy scout) camping. The evidence included several hearths filled with charcoal and melted bottle glass (spread over a wedge of land 0-75 m north and north northwest of the site), a large stone-ringed hearth and remains of post-in-ground plank benches (on the creek-bottom slump block), the remains of wooden signal towers (on the valley slopes northwest and southwest of the site), and more hearths and backfilled pits (on the creek mouth ridge and adjoining terrace to the south). On the crest of the creek mouth ridge, of course, we found the Sjovold brothers' 1965 backfilled test pit. Surface evidence for prehistoric occupation was generally very thin, but widespread. We found traces of chipped stone and broken bone on the north and south creek valley slopes with a slightly greater concentration along the abandoned road on both sides of the creek crossing.

Excavation of Test Profiles. Since preliminary investigations had shown that the most concentrated prehistoric archaeological remains lay at the south end of a small grassy creek-mouth ridge, the spot which the Sjovold brothers had tested in 1965, that is where we concentrated our

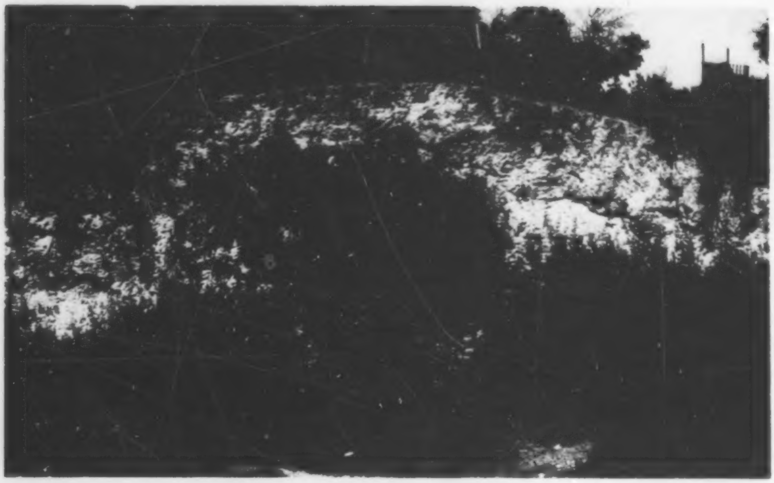


Figure 2.5. South-facing creek bank at the Sjovold site before excavation in July 1979. Range pole marks the location of eventual block excavations. RSM #EiNs-4:79-045 CT.

Figure 2.6. Excavation of test profiles 1, 2, and 3 (right to left) at the Sjovold site. RSM #EiNs-4:79-056 CT.

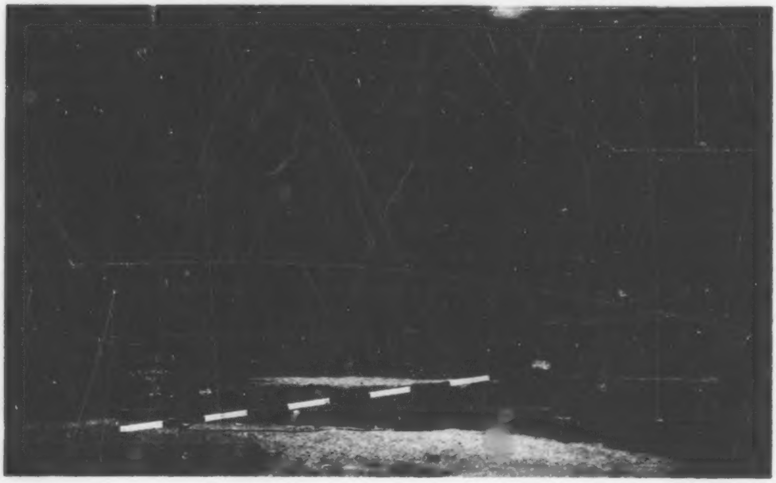


Figure 2.7. Test profile 2 with buried soils marking the locations of occupation layers I-XI. Pedestaled rocks at lower right belong to feature F8-a in Layer VIII. RSM #EiNs-4:79-065 CT.

Figure 2.8. Test profiles 4 (lower left) and 5 (lower right) revealing occupations layers XII-XXI and underlying gravel deposits. RSM #EiNs-4:80-369 CT.

attention. In order to test the depth and complexity of the cultural deposits, we shovelled and trowelled three 2 m x 2 m vertical profiles into the sandy silts at the top of the creek bank. The profiles were arranged over a 24 meter span centered on the crown of the cutbank, where the south end of an earthen ridge was being eroded by the northern crest of a meander in the creek (see Figs. 2.5-2.7). The profiles indicated that subsurface strata were flatter than the modern surface as little as 0.75 m below surface. From this we gathered that the ridge, which pinches into the creek mouth and which bears an important part of the site, is more prominent now than it was in earlier times. The profiles also revealed that there were many more buried occupation layers than we had expected, at least eight layers in the first two meters of deposits.

As we cut the profiles we sifted the earth removed from the cutbank through 6 mm (¼ inch) screens in order to gauge the concentration of artifacts at each location. The screens recovered a couple of kilograms of broken bones of large and medium-size mammals, pieces of broken rocks, chipped stone debris, a couple of flakes with chipped edges, and a few crumbs of pottery — all from a total of approximately 2.7 cubic meters of earth removed from the three profiles. One stone feature and one hearth feature were saved *in situ* and precise provenience was recorded for a few artifacts. That information was later added to data from adjoining layer excavations.

We stepped south about 0.5 m and extended the center and western profiles downward another 2.5 m until they reached more than 4.4 m below the crown of the bank (see Fig. 2.8). At the bottom of these deep profiles we encountered a massive layer of gravel, the top of the gravel being about 2 m above the bottom of the creek bed which was only a couple of meters to the south. Water levels in the creek fluctuated as much as a meter during the course of our work. During short periods of high water, the creek levels occasionally reached to the top of the gravel layer.

The deeper profiles revealed another 12 occupation layers, the deepest lying about 4.1 m below surface. This made a total of 20 buried layers of occupation. We made working drawings of the profiles and numbered the occupation layers from top to bottom in the order that they would be excavated. This gave us what we thought would be a superb guide to the positions and gross characteristics of the buried strata. The test profiles were maintained for constant reference throughout our investigations. In due course they were photographed and mapped in detail. Records for several artifacts and features situated in the profiles were eventually added to other information from the layers to which they belonged. Samples of broken bones clearly associated with specific layers were collected for use in radiocarbon dating.

We considered the idea of making a deep profile perpendicular to the creek bank in order to assess the cultural deposits northward along the creek-mouth ridge. That would have required removal of a large amount of earth, undisturbed deposits which, unlike those on the creek bank, were under no threat of erosion. Considering the limited amount of flat occupiable surface in the immediate

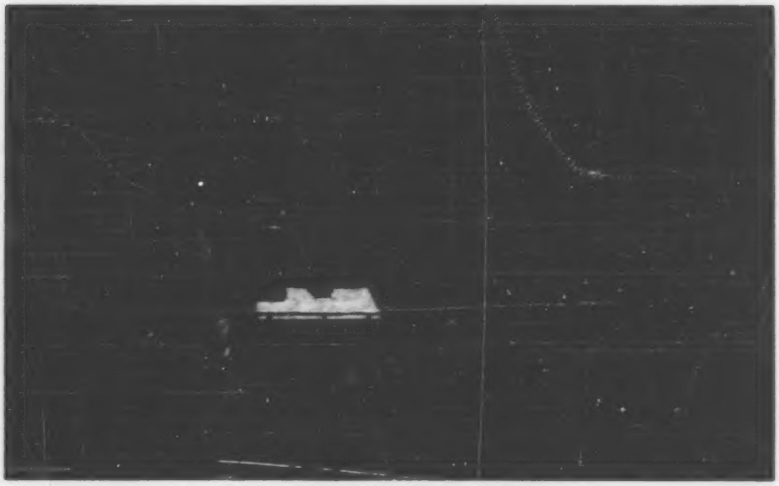


Figure 2.9. Mapping baselines at the Sjovold site. Site datum is inscribed on the large boulder in the center background. RSM #EiNs-4:79-011 CT.

Figure 2.10. Jean Prentice augering a test hole on the north-south baseline. RSM #EiNs-4:79-040b CT.

vicinity, particularly on the creek-mouth ridge we knew that making such a test trench risked considerable damage to cultural deposits which might be quite limited. We decided, instead, to settle for a modest post-hole augered exploration of near-surface deposits on the ridge.

Datum and Reference Grid. Before augering any post holes we established a site datum on a large prominent boulder situated near the basal juncture of the north creek valley wall and the west river valley wall. The boulder is about 80 m to the north (magnetic) of our creek bank test profiles. Next we made a north-south baseline roughly parallel to the long axis of the north creek-mouth ridge and along its east shoulder. We chose a zero point about 2 m north of the creek's cutbank and marked the baseline with wooden pegs at 2 m intervals from 0 to 10 m north and at 5 m intervals from 10 to 75 m north. We established a short east-west base line perpendicular to the north-south baseline at zero north (0n). It was marked with wooden pegs at 2 m intervals to distances of 10 m west and 10 m east. Two longer east-west baselines were established at 12.5n and 35n. These were marked with pegs at 5 m intervals extending up to 40w and 25e. The datum, baselines and creek bank were mapped and surface elevations were taken at the established points using an alidade (see Fig. 2.9).

Auger Testing. We augered a series of test holes along the main north-south baseline and along the east-west baseline through 12.5n (see Fig. 2.10). The purpose was to gain information about the locations of subsurface concentrations of artifacts and buried occupation layers along the ridge on which the baseline lay. Each hole was excavated with a hand auger having a bit diameter of 15 cm and a reach of 125 cm. We removed the earth in approximately 20 cm increments and screened it through 6 mm mesh. Artifact depths were usually recorded according to the 20 cm increment in which they were found, although sometimes we were able to be more precise. Notes were also made on soil colours and textures in the same fashion. Nineteen holes, spaced at 2.5 m intervals, were drilled along the north-south baseline between 0n and 45n. Traces of broken bone, rock, chipped stone debris, charcoal and the odd chipped stone tool were found scattered at various depths and at roughly the same density as had been found in the cutbank profiles. Changes in soil colour and texture were also noted for various depths which suggested that the stratified deposits continued throughout the span of our north-south tests.

We augered a series of 14 test holes along the east-west baseline, also at 2.5 m intervals, beginning at 5e and continuing to 25w. Pieces of chipped stone and bone were found at 3e which was where the shoulder of the ridge began to slope downward. Nothing was found in the test hole at 5e whose surface was 0.5 m below that of 3e and well down the slope of the shoulder. Moving in the other direction, test holes from 0w to 20w produced artifacts and soil colour and texture changes at various levels. This meant that stratified occupation deposits stretched across the ridge and part way down its west shoulder. It should be noted that the slope of the west shoulder was gentler than that of the east shoulder. From 20w to 30w the test holes showed colour and texture changes indicating the presence of stratified deposits, but only one of the holes, 27.5w, produced any artifacts. On the

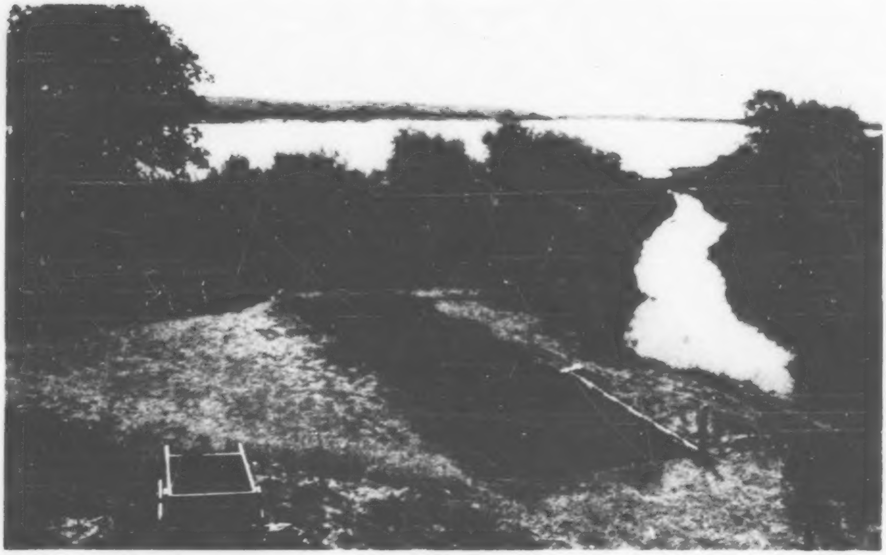


Figure 2.11. Location of excavation units 1, 2 and 3 some 2 m north of the creek bank. RSM #EiNs-4:80-109 CT.

basis of this information we concluded that buried occupation layers were concentrated on the crown of the ridge. While our auger testing could have been expanded both horizontally and vertically, we could see no compelling reason to do so and decided to select a site for block excavations on the basis of information then at hand.

Block Excavations. The site we selected was approximately 2 m north of the cutbank on the crown of the ridge (see Figs. 2.11-2.12). This place was chosen because: (1) according to our tests, artifacts seemed to be as concentrated there as anywhere else along the ridge, (2) at that location we could use the nearby cutbank profiles as a guide to the depth of occupation layers, and (3) in that position our excavations would envelop the Sjovold brothers' test pit, a consideration which might offer an opportunity to integrate artifacts they had recovered with any we might find (e.g. for ceramic vessel reconstruction), and at the same time one which minimized additional disruption of the landscape.

The area laid out for excavation measured 6 m east-west by 2 m north-south - large enough to promote recognition of small and medium occupation features, and small activity areas. If we were lucky, it would produce a useful sample of artifacts from each layer, hopefully including culturally

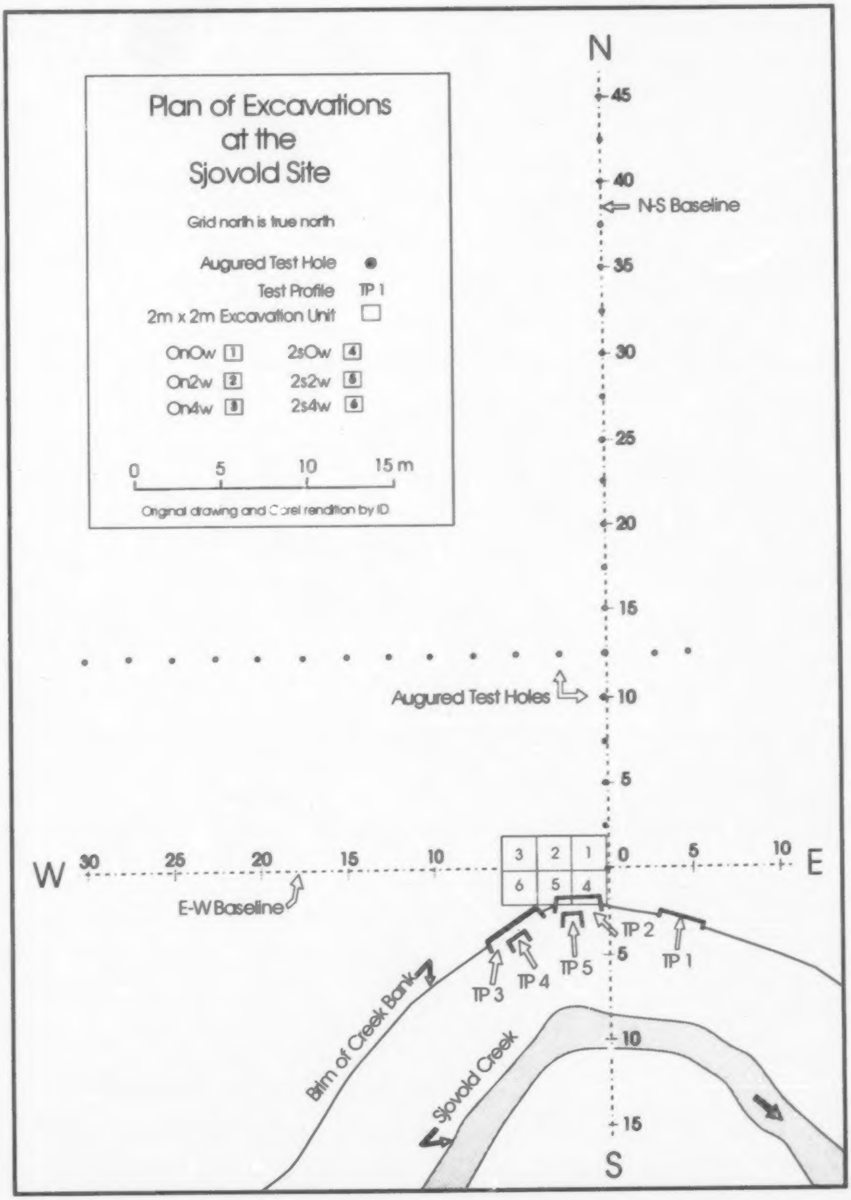

Plan of Excavations at the Sjovold Site
Grid north is true north
Augured Test Hole ●
Test Profile TP 1
2m x 2m Excavation Unit ☐
0n0w 1
0n2w 2
0n4w 3
2s0w 4
2s2w 5
2s4w 6
0 5 10 15 m
Original drawing and Corel rendition by ID
N
45
40
N-S Baseline
35
30
25
20
15
Augured Test Holes
10
5
W
30 25 20 15 10
0 5 10
E
E-W Baseline
3 2 1
6 5 4
TP 1
TP 2
TP 3
TP 4
TP 5
5
10
15
Brim of Creek Bank
Sjovold Creek
S

Figure 2.12. Plan of excavations at the Sjovold site.

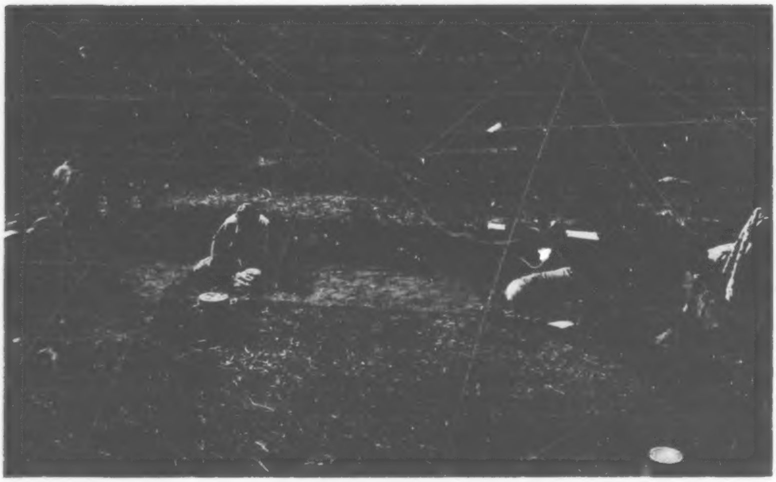


Figure 2.13. Exposing Layer II in excavation units 1, 2 and 3.
RSM #EiNs-4:79-093 CT.

diagnostic artifacts. In any case it was the largest area the Museum could afford to study intensively. The block to be excavated was laid out as three contiguous 2 m x 2 m squares, 0n0w, 0n2w and 0n4w, each taking its label from the coordinates of its southeast corner. The corners of each square were marked with wooden pegs driven into the ground. Small nails driven into the tops of the pegs served as anchors for strings which, suspended about 8 cm above the surface, marked the outside borders of the block. A secondary datum was established at 2n0w for measurements of depth which were taken with a line level and a measuring stake. Another secondary datum was established on a metal fence pole driven into the ground at 2n2w for depth measurements on artifacts below Layer X.

We removed the sod, to a depth of about 3 cm below surface, with flat-nosed shovels and discarded it without screening. We continued by shovel-shaving and screening (6 mm mesh) the deposits which we thought were those overlying Layer I (see Fig. 2.13). According to the profiles we expected to see a slightly darker soil and some larger artifacts as we came down on the top of the layer. We hoped to recognize the layer just as we began to encounter it in order to make the plane of exposure conform, as closely as possible, to the natural contours of that layer. Unfortunately, we misjudged the location of Layer I and passed through it into the interlayer below before we realized what had happened. This revealed a problem that we would have to contend with to the bottom of

Layer XXI - some occupation layers were extremely difficult to recognize in planview. Where differences in soil colour (or texture) between an occupation layer and its overlying (or underlying) deposits were slight or non-existent, and where there were also no features and very few artifacts to guide us, finding the layer became a serious problem. Should we go a couple of centimeters deeper on the assumption that the layer dipped a bit where we could not see it? A couple of centimeters more if we still had not found it?

Thus, despite the nearby test profiles, finding the layers in the block excavations turned out to be much more difficult than we expected. It required extremely acute observation of each part of an emerging surface, constant comparison between the test profiles and the profiles of the block excavation units, removal of only 1-2 cm deep layers of soil at a time in critical situations, and a fair bit of intuition. A saving grace was that, after passing through a layer, we could usually recognize it in the profiles of the excavation unit and supplement our records accordingly. The problem was not necessarily acute in all parts of a troublesome layer. Moreover, in some layers the problem was minimal. Unfortunately, Layer I presented a severe expression of the problem with the result that we have only a few artifacts and gross provenience records but no detailed planview drawings or photographs for that layer.

After Layer I we resolved to excavate no deeper than 2-3 centimeters below the depth at which we thought an occupation should lie before stopping to make planview drawings and photographs of the exposure. As a result we used 88 excavation levels to reach the bottom of the site, each level being customized to its situation (see Appendix A for a correlation of excavation levels, occupation layers and artifact catalogue numbers). Thus, while an interlayer might be removed as a single provenience unit up to 30 cm in thickness, an occupation layer and the deposits immediately above and below usually required several, sometimes many, thin levels for complete exposure, depending on layer thickness and complexity. Excavation levels within, on, or in close proximity to an occupation layer tended to be about 1-5 cm in thickness. The contents and elevations of each excavation level thought to be in or near an occupation layer were plotted on planview drawings and photographed *in situ*. Elevations were marked on planviews for the top of every object and feature that was plotted, and for numerous additional surface positions including at least the corners, centers and mid-sides of each excavation unit. The elevations were measured with a line level, string, and vertical measuring rod. The exact positions of parts of some occupation surfaces and the presence of some features were not recognized during excavations, but this method of excavation and record-keeping allowed their recognition and reconstruction in post-excavation analysis. Materials recovered in the screens were recorded according to excavation unit and level, although occasionally it was possible to specify the quadrant as well.

Exposure of excavation levels was accomplished with hand tools. Trowels and hand brushes were used for thin levels which were within or touching occupation layers. A combination of shovel-

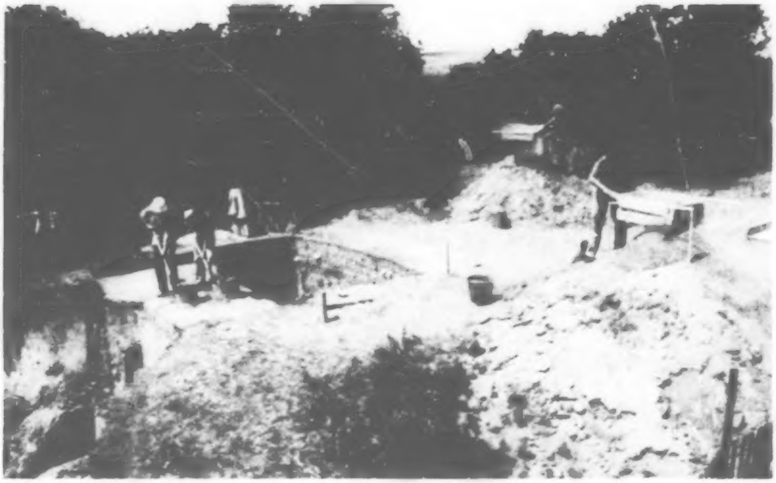


Figure 2.14. Removal of Layers I-IX from excavation units 4-6.
RSM #EiNs-4:80-111 CT.

skimming with square mouthed spades, or coal shovels, and trowelling was used for the interlayers. Almost all of the excavated deposits were sifted through 6 mm screens. Some interlayers, generally the siltiest ones, were exempted from screening (see layer by layer descriptions for particulars). Deposits from Layers I-X, generally the sandiest, were sifted through handscreens suspended from tripods. Deeper layers embedded in sediments with higher proportions of silt and clay were more difficult to screen, especially when damp. We used motorized screens for sifting the deeper deposits.

The sandy silt enclosing the stratified occupation layers proved to be well consolidated and extremely strong, while also being fairly easy to remove by trowel and shovel. We were surprised to see how well the walls of excavation units weathered two field seasons, standing straight without shoring, retaining structural integrity and a fair degree of surface smoothness through all sorts of weather. Despite the amazing strength of the deposit, we were unwilling to continue excavating below Layer X without protection from cave-ins. We discussed safety options with an experienced geological engineer and decided on an adjustment that would significantly improve our safety at acceptable costs, our strongest concerns being costs in additional time and money, in access and visibility, and in terms of damage to the surrounding archaeological deposits. The measure we decided upon involved stepping the whole excavation block two meters southward. This meant that Layers I-X had to be removed in

Figure 2.15. J. Ellis and D. Anderson collecting soil samples from the south-facing wall of excavation unit 1. RSM #EiNs-4:80-399b CT.

the new position before we could carry on to the deeper deposits. However, it also meant that most of the south edge of the new block would protrude through the creek bank into open air to Layer X or XI. This step minimized the threat of cave-ins on the north and south sides that were theoretically the weakest. It also gave the whole pit an increased margin of safety simply by increasing its size.

Excavation of Layers I-IX in the new block was done rapidly (see Fig. 2.14). Levels were fewer and thicker, and were made to correspond to occupation layers and interlayers according to the experience we had gained from the previous block excavations immediately to the north and the test profiles immediately to the south. Earth was removed with flat-nosed spades in about 2 cm layers and sifted with the power screens. This allowed a fair opportunity for the discovery of features in time to make a slow careful exposure with trowel and brush. Very few features were seen. In fact the whole artifact sample was smaller than that from the same layers only 2 m to the north. Layer X in the new block excavation was exposed with trowel and brush as we returned to the slower method of excavation developed in the old block. For a short time the whole exposure of Layer X, both in the bottom of the old block excavation and in the new, could be seen at once. After it was recorded we exposed Layer XI in the same way, all at once in both block excavations. Below Layer XI, the old block excavation pit was abandoned, except for recording a hearth feature that extended from unit

2s0w (XU4) into unit 0n0w (XU1) in Layer XII.

In general, all medium and small objects recovered from block excavations were saved and catalogued for later analysis. These included bones and bone fragments, coarse (unchipped) rocks and fragments of coarse rock, chipped stone debris, stone and bone tools, charcoal, seeds, mollusk and egg shells, fish scales, and concretions. Roots were discarded. So, too, were a substantial portion of the larger coarse rocks. We made observations about weight, size, material, colour, and surface condition for many of the large discarded rocks, but some, perhaps 5-10%, were discarded without such observations, an action we later regretted (see layer-by-layer analysis for particulars). Most of the recovered materials were lightly brushed either wet or dry before catalogue numbers were applied. However, during the winter of 1979-1980, it came to our attention that even this moderate amount of cleaning could remove residues of blood, fat, and hairs which might be of considerable interest. Thereafter we ceased washing tools and chipped stone debris, and limited their handling and cleaning to the minimum necessary for complete exposure of surfaces and application of a catalogue number.

Commissioned Studies. In addition to the archaeological investigations, several collaborators were engaged for specialized studies of the past and present environmental setting of the site. These included Z. Abouguendia, et al. (1981) on vascular plants of the Sjovold locality; E.A. Christiansen (1980) on geology of the Sjovold locality; Hugh E. Hendry (1981) on sediments of the Sjovold site; D.W. Anderson and J.G. Ellis (1981) on soils of the Sjovold site (see Fig. 2.15); and Prairie Mapping Ltd. for a topographic map of the Sjovold site and vicinity. The main conclusions of the botanical study are summarized in Chapter 1, and the three reports on geology, sedimentology and soils are presented in Chapter 3. The map forms the basis for Figure 2.3.

Chapter 3

Stratigraphy and Chronology

Introduction

The Sjovold site has been studied from the standpoint of regional geology, sedimentology and soils, and reports by specialists in these fields provide a basis for constructing the natural stratigraphy of the site. We are pleased to include the specialists' reports in this chapter, acknowledging their authorship and allowing each contribution to speak for itself. First, however, we introduce our collaborators and show how their observations and analytical data can be integrated into a holistic view of the site deposits.

The geology of the Sjovold site is presented by Earl A. Christiansen, a consulting geologist based in Saskatoon. Site sedimentology is described and interpreted by Hugh E. Hendry, Department of Geological Sciences, University of Saskatchewan. D.W. Anderson and J.G. Ellis, Saskatchewan Institute of Pedology, consider the character and implications of buried soil horizons observed in the excavations. These contributions were originally delivered, in 1980 and 1981, as manuscript reports that remain on file at the Royal Saskatchewan Museum in Regina. We have edited the reports to reflect their placement in this monograph, and we have revised this chapter after presenting a draft of it to each of the collaborators. To aid the presentation we introduce "Sjovold Creek" as an informal name for the tributary stream on which the Sjovold site is located.

Each of the reports probes the Sjovold site deposits to a degree and depth appropriate to its purpose. For example, Christiansen's review of geology accounts for the bedrock as well as the unconsolidated sediments, and he identifies a till that underlies a sequence of three major sedimentary units — alluvium, interbedded alluvial and aeolian sediments, and aeolian deposits. Hendry's study excludes the till because it is not actually exposed at the site and is known locally only from augerholes. Hendry recognizes the same three sedimentary units overlying the till, and his description begins with the upper third of the alluvium where the site excavations provided a directly observable section. Anderson and Ellis confine their observations and sampling to the aeolian deposits at the top of the section where buried soil horizons are seen. A dark coloured layer (Layer XVII) midway through the interbedded alluvial and aeolian sediments was sampled by Anderson and Ellis but was found to be an ash-rich layer rather than a soil horizon, and it is noteworthy that we had independently interpreted the Layer XVII deposits as representing a large roasting trough.

Figure 3.1 presents a correlation of these studies along with the numbering of archaeological layers. The scale in Figure 3.1 is based on measurements below the surface at 2n2w through Layer XII and 0n2w through deeper layers. Depth measurements recorded by our collaborators were made

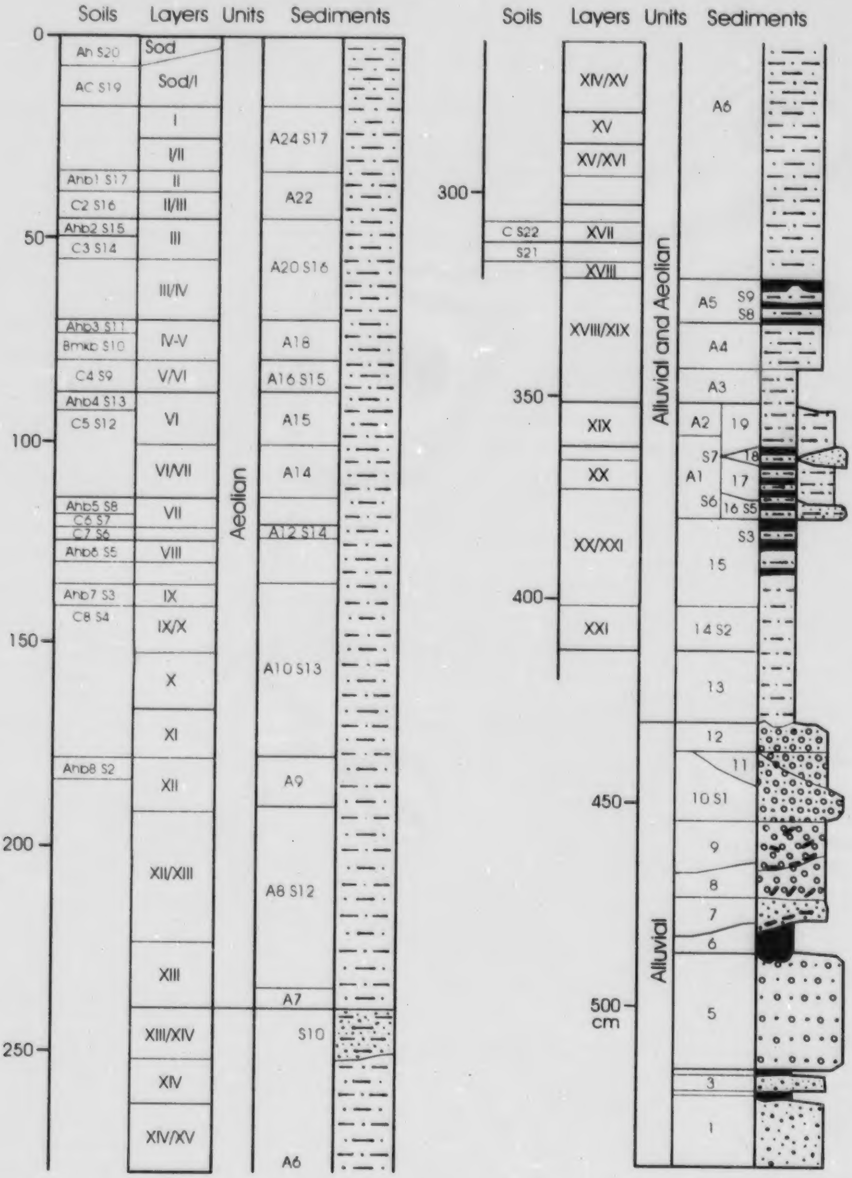

Soils
Layers
Units
Sediments
0
50
100
150
200
250
An S20
AC S19
Anb1 S17
C2 S16
Anb2 S15
C3 S14
Anb3 S11
Bmkb S10
C4 S9
Anb4 S13
C5 S12
Anb5 S8
C6 S7
C7 S6
Anb6 S5
Anb7 S3
C8 S4
Anb8 S2
Sod
Sod/I
I
I/II
II
II/III
III
III/IV
IV-V
V/VI
VI
VI/VII
VII
VIII
IX
IX/X
X
XI
XII
XII/XIII
XIII
XIII/XIV
XIV
XIV/XV
Aeolian
A24 S17
A22
A20 S16
A18
A16 S15
A15
A14
A12 S14
A10 S13
A9
A8 S12
A7
S10
A6
300
350
400
450
500
cm
C S22
S21
XIV/XV
XV
XV/XVI
XVII
XVIII
XVIII/XIX
XIX
XX
XX/XXI
XXI
Alluvial and Aeolian
Alluvial
A6
A5
S9
S8
A4
A3
A2
19
S7
18
A1
17
S6
16 S5
S3
15
14 S2
13
12
11
10 S1
9
8
7
6
5
3
1

Figure 3.1. Schematic stratigraphic profile of the Sjovold site showing correspondence between cultural layers, Hendry's sediment beds and sample numbers, Anderson's and Ellis' soil horizons and sample numbers, and Christiansen's three major units.

at other locations as dictated by their need to study particular sections, and these do not always precisely match one another due to variations in the thickness and orientation of layers across the site. One purpose of Figure 3.1 is to reconcile all of the observations with a single vertical scale, and to avoid confusion we have removed most depth measurements from the individual reports.

Following the presentation of geology, sedimentology and soils, the chapter continues with an analysis of 24 radiocarbon dates to produce a calibrated site chronology. It concludes with the cultural stratigraphy of the site, including detailed descriptions of the occupation layers.

Geology of the Sjovold Site, by Earl A. Christiansen

Objectives of Previous and Present Studies

The objective of this study is to provide a geologic framework for the Sjovold site including (1) stratigraphy as it pertains primarily to a cross-section across the Sjovold Creek valley; (2) geomorphology; (3) geologic processes that were operative during and since the formation of the site; and (4) the geologic history of the site. The Sjovold site is located in the Rosetown map-area (N.T.S. 72-O) where previous work has focused on bedrock, glacial deposits, and groundwater resources investigated by test drilling (Christiansen and Meneley 1971), surficial deposits and deglaciation history (Scott 1971), and soils (Ellis, et al. 1968). The history of the last deglaciation of the site area is included in the Wisconsinan deglaciation of southern Saskatchewan and adjacent areas (Christiansen 1979).

This study is based on brief examinations of the Sjovold site on 26 June 1980 with Ian Dyck, and on 1 October 1980 with D.W. Anderson, J.G. Ellis, H.E. Hendry, and Ian Dyck. In addition, eight augerholes were drilled into the underlying till on 23-24 October and 8 November 1980. The augerhole locations were plotted on an aerial photograph (Fig. 3.2), and their elevations were obtained by hand level surveys with the top of the Sjovold site set at a datum of 30 m. Distances between augerholes were measured by tape. Samples were taken off the continuous auger flights at about one metre intervals. The samples were placed in muffin tins, dried, and described with the aid of dilute hydrochloric acid, a hand lens and a Munsell Color Chart. Based on the sample descriptions and field logs, geologic logs were compiled for use in constructing a cross-section across the Sjovold Creek valley (Fig. 3.3).

Bedrock and Glacial Tills

The Sjovold site is underlain by the Bearpaw Formation (Christiansen and Meneley 1971). According to Christiansen and Meneley (1971), the bedrock surface is about 12.2 m below the top of the Sjovold site, but an augerhole drilled there indicates that at least 15.2 m of glacial and postglacial

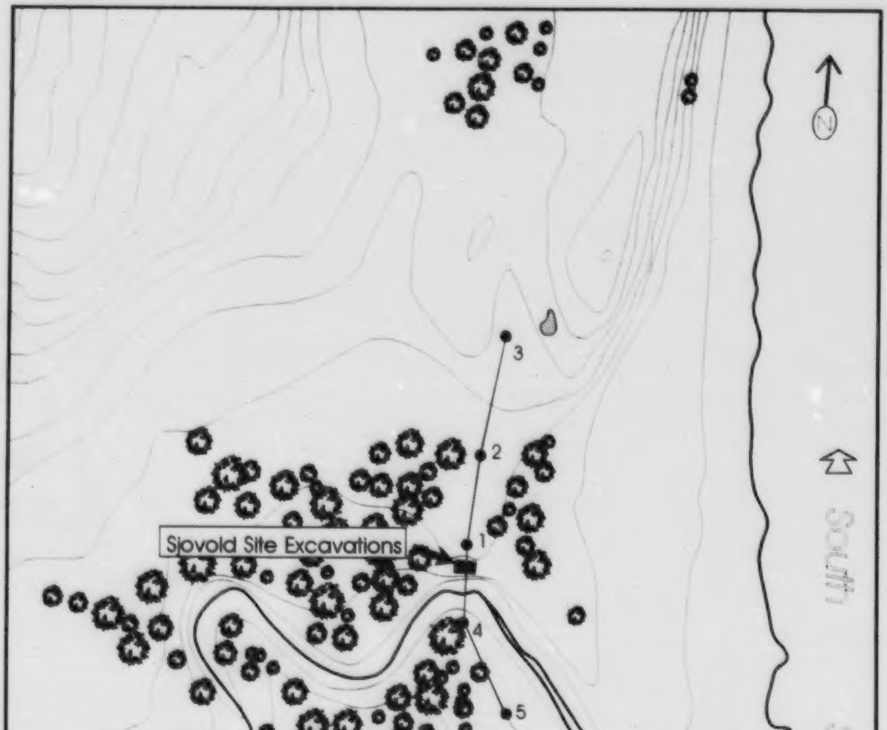
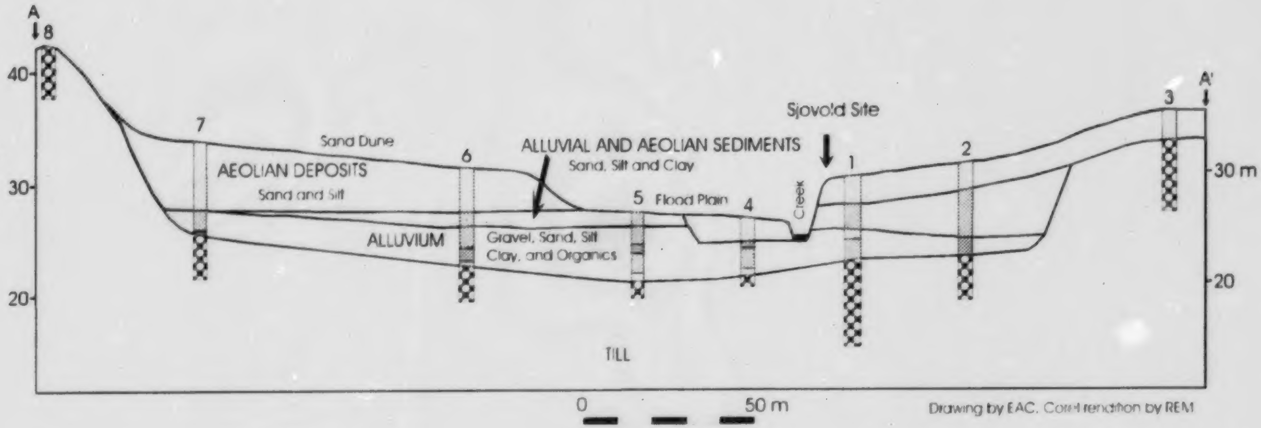

N
Sjovold Site Excavations
1
2
3
4
5
6
7
8
South Saskatchewan River
Sjovold Creek
0 10 20 30 40 50 m
contour interval is 2 m
Augerhole
Treed area
Base map by Prairie Mapping Ltd. Corel rendition by ID

Figure 3.2. Map of the Sjovold site showing the locations of geological augerholes and cross-section A-A'.


A
8
A'
3
40
30
20
30 m
20
7
6
5
4
1
2
Sjovold Site
Sand Dune
AEOLIAN DEPOSITS
Sand and Silt
ALLUVIAL AND AEOLIAN SEDIMENTS
Sand, Silt and Clay
Flood Plain
Creek
ALLUVIUM
Gravel, Sand, Silt
Clay, and Organics
TILL
0
50 m

Drawing by EAC. Corel rendition by REM

Figure 3.3. Cross-section A-A' across the Sjovold Creek Valley shown with vertical exaggeration 1.6x and vertical datum set at 30 m for the surface of the Sjovold site (redrawn after Christiansen 1980: Drawing 0050-001-01; see Fig. 3.2 for augerhole locations).

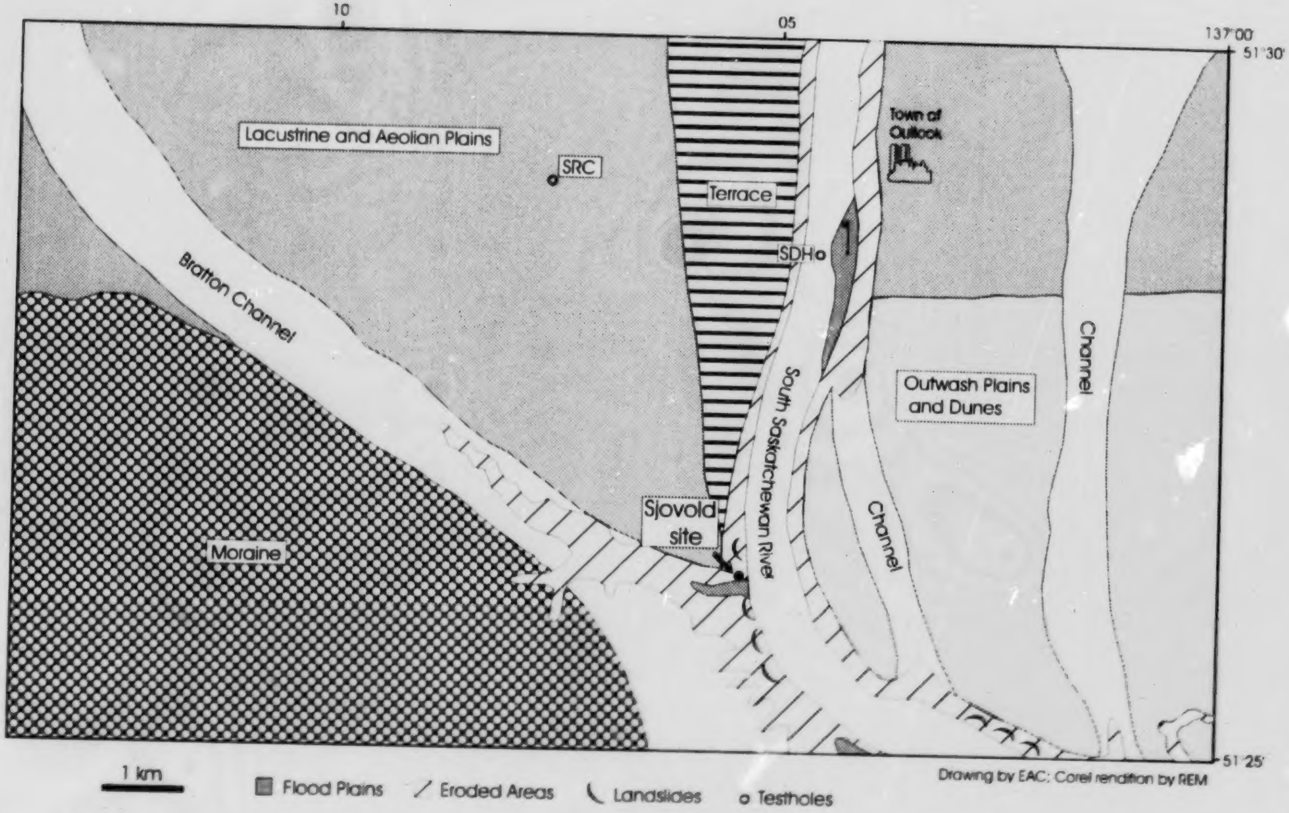

10
05
137°00'
51°30'
51°25'
Lacustrine and Aeolian Plains
SRC
Terrace
SDH
Town of Outlook
Bratton Channel
South Saskatchewan River
Outwash Plains and Dunes
Channel
Channel
Sjovold site
Moraine
1 km
▨ Flood Plains
/ Eroded Areas
(Landslides
o Testholes
Drawing by EAC; Corel rendition by REM

Figure 3.4. Surficial deposits of the Sjovold site - Outlook area, based mainly on Ellis, et al. (1968) and Scott (1971).

deposits overlie the bedrock at the site. Bedrock crops out along the South Saskatchewan River about 5 km downstream and about 1 km upstream from the Sjovold site (Christiansen and Meneley 1971).

According to the Saskatchewan Research Council testhole at Outlook, tills named the Sutherland Group and Floral and Battleford Formations (Christiansen 1968a, 1968b) are present about 5.5 km north of the Sjovold site. However, the clayey nature and olive-brown weathering of the till beneath the site (Fig. 3.3) suggest that this till belongs to the Sutherland Group. The younger tills were removed by fluvial erosion when the Sjovold Creek valley was formed.

Geomorphology

Landforms in the Sjovold-Outlook area include moraine, outwash plains, dunes, channels, terraces, lacustrine and aeolian plains (undifferentiated), flood plains, landslides, eroded areas, and the South Saskatchewan River (Fig. 3.4). Most of the surface till, where erosion has not occurred, is composed of soft, unjointed and unstained till of the Battleford Formation (Christiansen 1968a). Outwash sands and gravels south of Outlook were deposited during the last deglaciation, but the exact nature of their origin has not been investigated. Parabolic blowout dunes occur in the outwash deposits and channels south of Outlook where the dune sand was derived from the outwash sand. According to Scott (1971), the dunes are mainly stabilized and were formed by northwesterly winds.

The Bratton Channel and the two channels south of Outlook are the main channels in the area. Although the nature of their sediments has not been studied, the age and origin of these channels is described below. A well developed terrace occurs west of the South Saskatchewan River opposite Outlook. It is covered with sand and gravel (now being borrowed) and with silt (Ellis, et al. 1968) which is probably aeolian in origin. Figure 3.4 shows undifferentiated lacustrine and aeolian plains in the vicinity of Outlook and extending northwest of the Sjovold site. According to Ellis, et al. (1968), these plains are covered with lacustrine silts and clays. Reconnaissance work in the Sjovold site area suggests that some of these areas either are covered with wind-blown silt and sand blankets or are entirely aeolian.

Flood plains occur at the mouth of Sjovold Creek and under the Outlook Golf Course (Fig. 3.4). The flood plain sediments at the Sjovold site are composed of up to 6.5 m of interbedded gravel, sand, silt, clay and organic material (Fig. 3.3). Landslides along the South Saskatchewan River form elongated, arcuate slumped ridges in the valley slopes, and they are discussed in more detail below. Eroded areas occur in the banks of the South Saskatchewan River Valley and its tributaries. The sediments are composed of colluvium, including slumped material, and alluvium at the base of slopes where river ice has also pushed up material from the river bed.

A Saskatchewan Department of Highways (SDH) testhole at Outlook shows that more than 30 m of sand occurs beneath the South Saskatchewan River (Scott 1971:27). The top of this fill exhibits a braided pattern with sand bars emerging during low stages of the river. Although the upper part of the fill is alluvial, it is conceivable that the lower, older part of the fill may be glacial or proglacial, emplaced when the valley functioned as a spillway draining southward.

Stratigraphy of the Sjovold Site

In ascending order, the Sjovold site is underlain by till, alluvium, alluvial and aeolian sediments, and aeolian deposits. There is more than 8 m of dark gray, clayey, slightly calcareous till, the upper part of which is jointed and stained to a light olive-brown colour. The clayey nature and low carbonate content of this till along with the olive colour of the weathered zone suggest that it belongs to the Sutherland Group as defined by Christiansen (1968b).

The alluvium lies in the flood plain of Sjovold Creek between till and the overlying interbedded alluvial and aeolian sediments (Fig. 3.3). The upper contact of the alluvium is taken at the base of the lowest, massive, well-sorted, fine-grained sand which is interpreted as aeolian. The alluvium is composed of up to 5 m of poorly sorted gravels and sands, silts, and clays and is locally carbonaceous and wood-bearing.

Between the basal alluvium and the surficial aeolian deposits is a zone interpreted as interbedded alluvial and aeolian sediments. The lower contact is marked by the base of the lowermost massive, well-sorted, fine-grained sand, and the upper contact is marked by the top of the uppermost clayey silt bed. These sediments are composed of silty, fine-grained, massive sand interbedded with sandy and clayey silt beds. It is possible that some of the sandy silt is also aeolian. However, the uppermost silt bed in the Sjovold site excavation is too clayey to be aeolian. At the site itself, most of the alluvial and aeolian zone is aeolian and becomes more so toward the top of the exposure.

Aeolian deposits extend northward from the Sjovold site and in a ridge extending into the flood plain from between Augerholes 8 and 7 to between Augerholes 6 and 5 (Fig. 3.2). The deposits are composed of fine- to very fine-grained massive, silty, well-sorted, greyish brown and dark greyish brown sand. The lower contact is marked by the top of the uppermost clayey silt bed.

Geologic Processes

Fluvial erosion and sedimentation, landslides, and aeolian deposition are the main processes that were and are operative in the vicinity of the Sjovold site. Glacial meltwater and postglacial runoff eroded the Sjovold Creek valley. The South Saskatchewan River changed its direction of flow from south to north when it stood at about 534 m at the Sjovold site. Erosion of the valley to this depth was accomplished by the south-flowing South Saskatchewan Spillway, whereas erosion below this elevation at the Sjovold site was accomplished by the north-flowing South Saskatchewan River.

According to Scott (1971) and the SDH Outlook testhole, more than 30 m of sand fills the

South Saskatchewan River Valley at Outlook and Gardiner Dam. Although the origin of this deep erosion and thick fill is uncertain, it must have taken place prior to the erosion of the Sjovold Creek valley, because the bottom of this valley is only a few metres below the top of the sand fill in the river valley. It is possible that this cut and fill predates the last glaciation or that it represents a subglacial cut and fill that took place during the last glaciation.

The alluvial fill in the Sjovold Creek valley appears to be related to alluviation of the South Saskatchewan River which acted as a base level for the creek. The alluvial deposits in the interbedded alluvial and aeolian sediments are believed to have been laid down during ice jamming of the South Saskatchewan River causing flooding of the Sjovold Creek valley. Such ice jamming along this stretch of the South Saskatchewan River was common prior to the construction of the Gardiner Dam (Don MacRae, pers. comm., 1980).

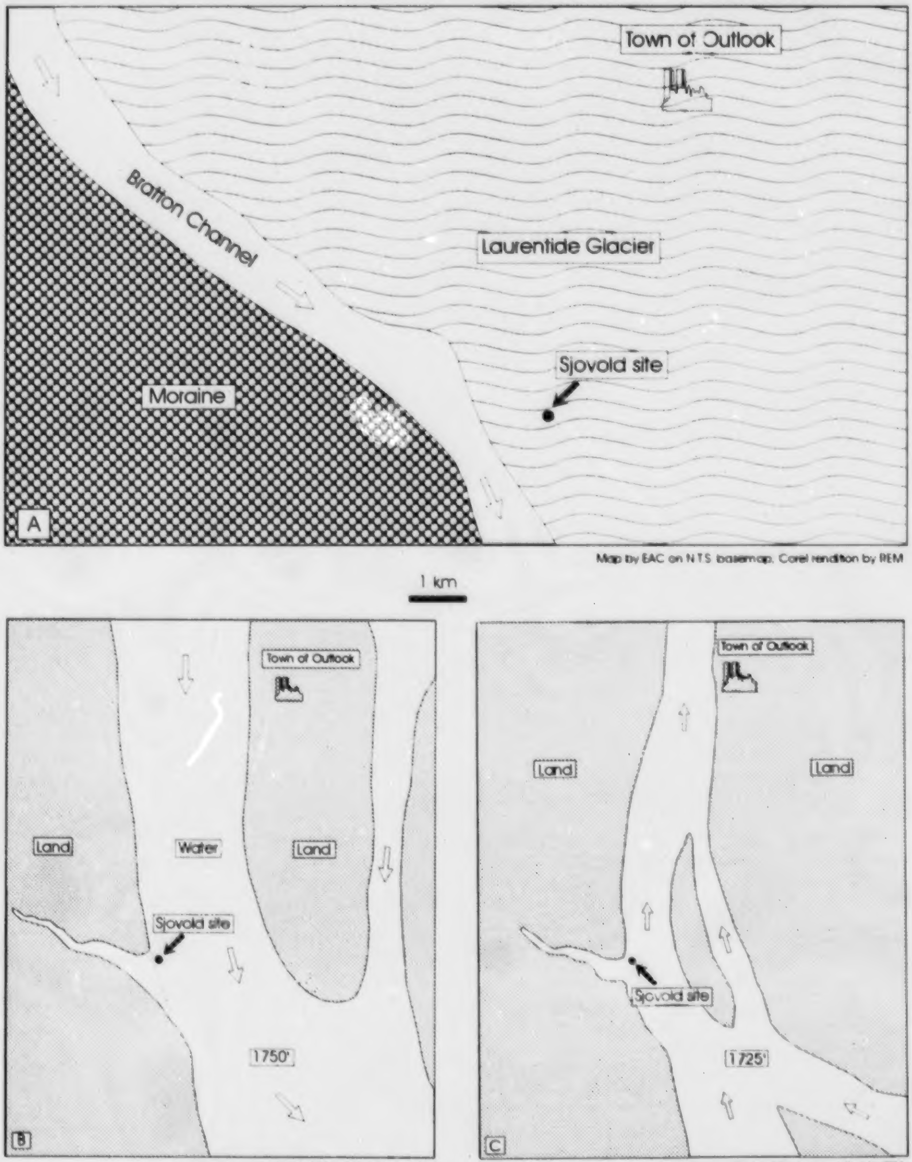
According to Scott (1971), the banks of the South Saskatchewan River exhibit extensive areas of landslides. These form a series of elongated, arcuate ridges that parallel the river. The failure surfaces invariably extend into the underlying bedrock of the Bearpaw Formation, and thus both bedrock and glacial deposits are included in the landslides (Scott 1971). To the north and south of the Sjovold site, extensive landslide ridges parallel the South Saskatchewan River, and these may account for the lower than expected elevation of the bedrock surface.

Massive, silty, very fine- to fine-grained sands with buried A-horizons are indicative of aeolian deposits at the Sjovold site. Where these deposits occur on top of cliffs along valleys, they are called cliff-top deposits by David (1970) who considers them to be wind-blown sediments derived from the cliff face. Such deposits occur in exposures along the cliff top of the South Saskatchewan River north of the Sjovold site, and these were traced to the site itself (Fig. 3.3).

Aeolian deposits form a well defined ridge from between Augerholes 8 and 7 to between Augerholes 6 and 5 (Fig. 3.2). At Augerhole 7 Sjovold Creek was blocked by the sand ridge. Although some of these wind-blown deposits may have been derived from the cliffs as David (1970) concluded, it is thought that most of these deposits at the Sjovold site were derived from the braided South Saskatchewan River bottom during low water stages. During my visits to the site on 1 October 1980, sand was being deflated from the sand bars along the river. It is further thought that this well developed sand ridge might be the result of the 8 km sweep that southeast winds would have to deflate sand from the sand bars during low river stages. Such a direction of deflation would explain the northward growth of this ridge across the Sjovold Creek valley.

Geologic History

The geologic history of the Sjovold site is considered for three time intervals: (1) history of deglaciation of the site between about 13,000 and 10,000 years ago; (2) postglacial history between about 10,000 and 4,500 years ago; and (3) postglacial history from 4,500 years ago to present. The

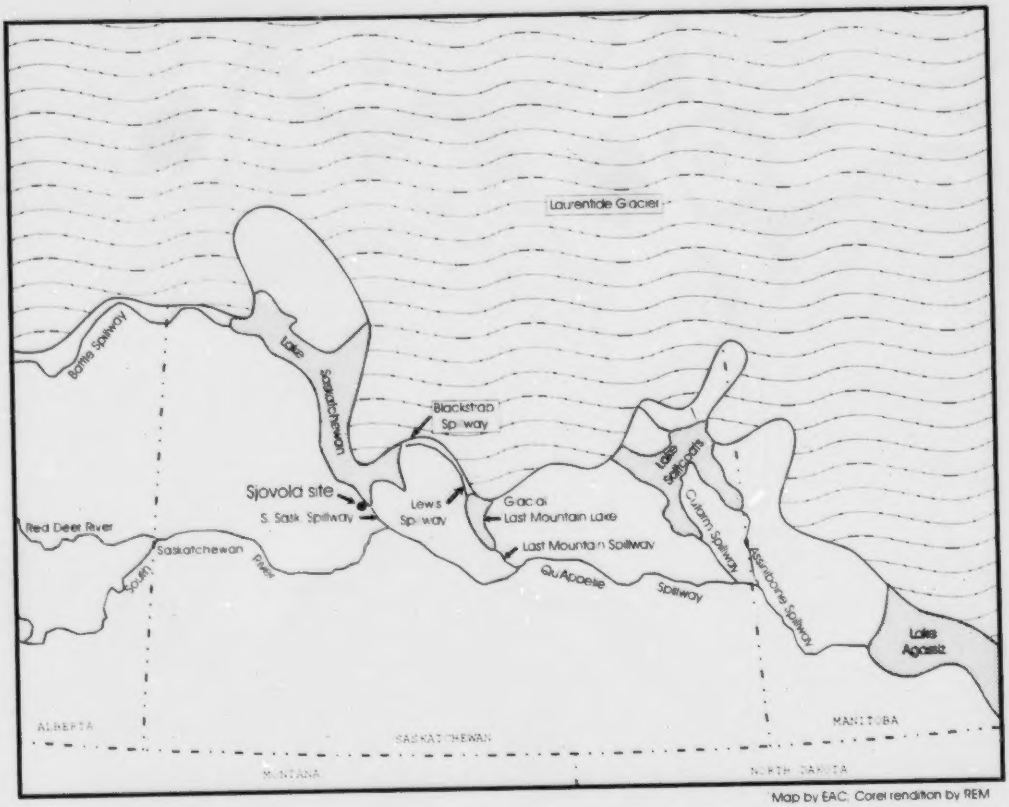

Town of Outlook
Bratton Channel
Laurentide Glacier
Sjovold site
Moraine
A
1 km
Town of Outlook
Land
Water
Land
Sjovold site
1750'
B
1 km
Town of Outlook
Land
Land
Sjovold site
1725'
C
1 km

Map by EAC on N.T.S. basemap. Corel rendition by REM

Map by EAC. Corel rendition by REM

Map by EAC. Corel rendition by REM

Figure 3.5. History of deglaciation of the Sjovold site: A, Phase 1, showing the glacier standing north of the Bratton Channel (after Scott 1971: Fig. 29, Phase 6); B, Phase 2, showing the South Saskatchewan Spillway draining into the Qu'Appelle Spillway; C, Phase 3, showing the South Saskatchewan River coming into existence.


Laurentide Glacier
Battle Spillway
Lake Saskatchewan
Blackstrap Spillway
Sjovold site
S. Sask. Spillway
Lewis Spillway
Glacial Last Mountain Lake
Last Mountain Spillway
Red Deer River
South Saskatchewan River
Qu'Appelle Spillway
Lake Souris
Cutarm Spillway
Assiniboine Spillway
Lake Agassiz
ALBERTA
SASKATCHEWAN
MANITOBA
MONTANA
NORTH DAKOTA

Map by EAC; Corel rendition by REM

Figure 3.6. State of deglaciation in southern Saskatchewan about 12,500 years ago (after Christiansen 1979: Fig. 14).

first of these intervals, the deglaciation history, is shown in three phases (Fig. 3.5). The regional history of deglaciation, including the Sjovold site, follows Scott (1971) and Christiansen (1979).

Phase 1. According to Scott (1971), the Bratton Channel, which initiated the formation of the Sjovold Creek valley, was formed when the glacier stood immediately north of the channel (Fig. 3.5A). According to Christiansen (1979), Phase 1 took place before 12,500 years ago, probably about 13,000 years ago. At the Sjovold site, the Bratton Channel was eroded to an elevation of about 564 m during Phase 1. As the glacier retreated northward and Lake Saskatchewan fell, the Bratton Channel was abandoned as a glacial spillway, and erosion by postglacial runoff was initiated at the Sjovold site.

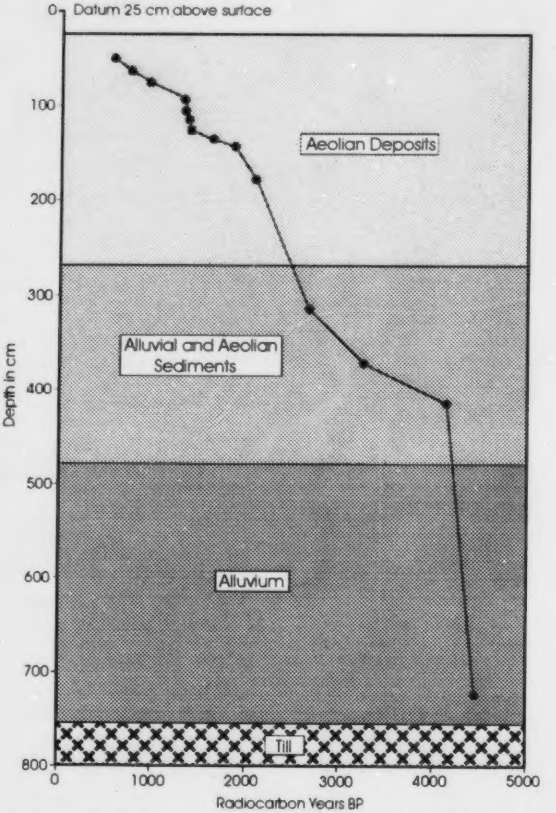


Figure 3.7. Relationship between age and depth of sediments at the Sjovold site (see Table 3.6).

Phase 2. Between Phases 1 and 2 (Figs. 3.5A-B), the glacier stood at about the position shown in Figure 3.6. During this interval, the South Saskatchewan Spillway was eroded to an elevation of about 534 m at the Sjovold site (Fig. 3.5B). At this time, as was the case during Phase 1, Lake Saskatchewan drained southward through the South Saskatchewan Spillway into the Qu'Appelle Spillway (Fig. 3.6). The outwash plain east of the South Saskatchewan River (Fig. 3.4) was formed between Phases 1 and 2, and dune activity was initiated at this time. As the glacier retreated, glacial lake silts and clays were laid down in Lake Saskatchewan. As the lake fell to 534 m, some of these lacustrine sediments were undoubtedly covered by wind-blown silt derived from the outwash deposits and sand bars that probably existed in the river at that time.

Phase 3. Between Phases 2 and 3 (Figs. 3.5B-C), the south-flowing South Saskatchewan Spillway was abandoned, and the north-flowing South Saskatchewan River was initiated. This change in direction of the river took place between elevations of 534 m and 526 m at the Sjovold site. When the South Saskatchewan River started to erode below 518 m, the channel east of the present river (Fig. 3.4) was abandoned, and its sand was reworked into dunes. The South Saskatchewan River continued to downcut as Lake Saskatchewan and Lake Agassiz fell until about 10,000 years ago (Christiansen 1979: Figs. 16-18). As the South Saskatchewan River downcut, the Sjovold Creek valley was eroded. If the South Saskatchewan River Valley was eroded to the base of its present fill at this time, such erosion and subsequent filling must have taken place before the Sjovold Creek valley could be eroded. It seems more likely, however, that the alluvial fill in the South Saskatchewan River Valley predates the last deglaciation and that the base of the alluvium in the Sjovold Creek valley (Fig. 3.3) marks the approximate depth to which the river valley was eroded during the last deglaciation.

Sediments recording the first half of postglacial history (10,000 to 4,500 years ago) have not been identified at the Sjovold site. It is thought that either the Sjovold Creek valley was being continually eroded during this interval or sediments were not being deposited on the creek valley floor.

During later postglacial history (4,500 years ago to present) most if not all of the alluvium, the alluvial and aeolian sediments, and the aeolian deposits were laid down at the Sjovold site (Fig. 3.7). The alluvium was deposited from about 4,500 to 4,000 years ago, the alluvial and aeolian sediments from about 4,000 to 2,500 years ago, and the aeolian deposits from 2,500 years ago to present. Habitation by people started when the Sjovold site was sufficiently above the flood plain so that only occasional floods, probably caused by ice jamming, inundated the site. During these interflood intervals, aeolian sands were deposited at the site to form the interbedded alluvial and aeolian sedimentary unit. Human activity continued at the site during the intervals between deposition of the upper aeolian deposits. During these intervals incipient soils developed in these wind-blown sediments.

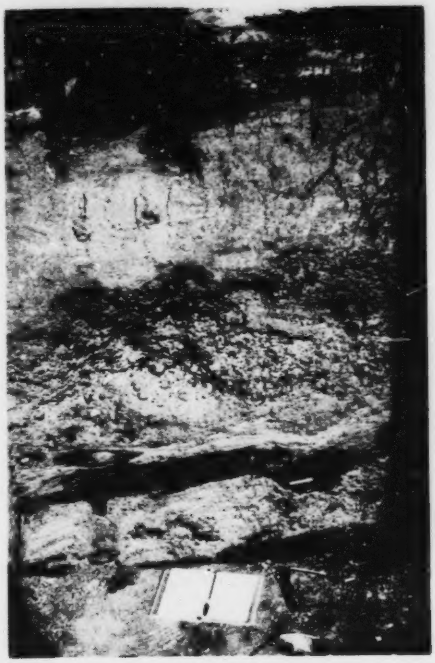


Figure 3.8. Lower part of the Sjovold site section with gravels at the base and stratified silts above (photo by H.E. Hendry).

Sedimentology of the Sjovold Site, by Hugh E. Hendry

Introduction

The sedimentary sequence at the Sjovold site contains gravel, sand, silt and clay beds. The sedimentological investigation of the sequence included construction of a stratigraphic section for the deposits exposed in the archaeological excavations, collection of samples from the sandy and finer grained beds for grain size analysis, and recording of sedimentary structures for interpretation of mode of deposition. The thickness of the measured section was 5.43 m with the top of the section set at archaeological Level 1. The section can be conveniently divided into three units: bedded sandy gravels with clays (Alluvium, Fig. 3.1); stratified silts (Alluvial and Aeolian); and structureless silts and sands (Aeolian).

Table 3.1. Grain size distributions (%) of samples taken for sedimentological analysis.

Bed	Sample	Sand >50μ	Coarse Silt 50-20μ	Medium Silt 20-5μ	Fine Silt 5-2μ	Clay <2μ
A24	S17	60.0	31.5	1.3	6.4	0.8
A20	S16	73.0	18.5	6.5	1.2	0.8
A16	S15	31.0	37.0	25.5	5.2	1.3
A12	S14	44.0	44.0	9.8	1.2	1.0
A10	S13	62.0	31.3	4.7	0.7	1.3
A8	S12	41.0	45.0	10.5	2.4	1.1
A6	S10	73.0	21.5	4.1	0.2	1.2
A5	S9	35.0	35.0	21.5	3.0	5.5
A5	S8	71.0	21.5	5.7	1.0	0.8
A1	S7	10.0	40.0	41.5	7.3	1.3
A1	S6	32.0	57.0	9.7	0.2	1.1
16	S5	50.0	36.0	13.0	0.4	0.6
15	S4	8.0	34.0	38.0	14.2	5.8
15	S3	14.0	73.0	11.6	0.3	1.1
14	S2	23.0	42.0	25.0	5.0	5.0
10[a]	S1	96.9	0.0	3.2	0.0	0.0

a. sample contained the matrix only of a gravel layer.

The Stratigraphic Section

The principal features of the measured section are summarized in Figure 3.1. The main differences among the three major units are in the types of sedimentary structure, principally bedding, and in grain size. Grain size was analyzed by Rita Tobin, using the dry sieving method of Folk (1968) with portions finer grained than 0.625 mm analyzed using the pipette method. The results were plotted as cumulative curves using the ϕ (Phi) terminology of Krumbein (1934; Hendry 1981). However, for purposes of this report the analytical data have been retabulated in terms comparable to those used in the soils analysis (Table 3.1). All of the samples analyzed were taken from the stratified silts and the structureless silts and sands. Most of the samples contain little clay, and the samples with the highest proportions of clay are those taken from the fine-grained layers in the stratified silts. The grain size analyses by themselves cannot indicate environment of deposition, as discussed below.

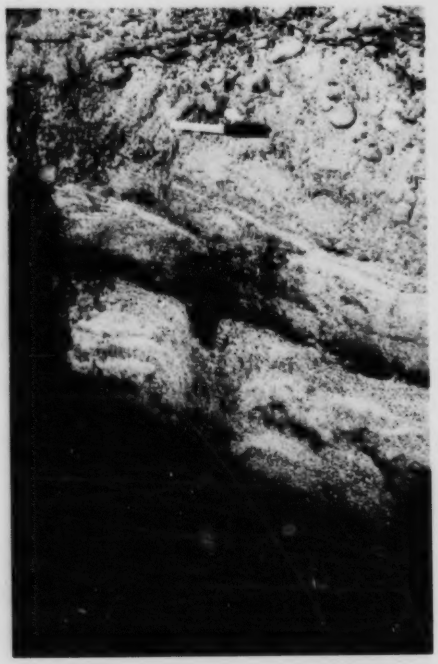


Figure 3.9. Clay filling a depression over disturbed sand, a hoof-print structure or a feature produced by frost wedging (photo by H.E. Hendry).

Bedded sandy gravels with clays. The lowermost 1.15 m of the section (Fig. 3.8) contain mainly gravel or sand beds up to 30 cm thick separated by thin discontinuous lenses of clay. Bed thickness is variable over even the short distances exposed in the excavation, and beds change thickness by as much as 10 cm in lateral distances of less than 1 m. There are also marked lateral changes in grain size; bed #5 passes from a cobbly gravel with clasts up to 60 mm across to a cross-bedded coarse-grained sand in a lateral distance of 50 cm. Most of the clasts in the gravels are around 10-20 mm long and are set in a sandy matrix. The bulk of the gravel clasts are resistant pebbles that likely were derived from glacial deposits, but most of the gravel beds contain some soft, rounded clay pebbles that must have been transported only very short distances in order to avoid complete destruction by abrasion. All of the gravel and sand beds have erosional scour contacts with underlying layers. Cross-bedding is common and, in this part of the section, indicates flow towards the southwest.

Interbedded with the sands and gravels are thin discontinuous clay beds ranging in thickness from paper-thin up to about 15 cm. Within individual beds thickness is highly variable, because the clay commonly was deposited on an uneven gravel or sand surface producing an original depositional variability, and many of the clay layers were partly eroded before deposition of the overlying bed producing an erosional variability in thickness. At the top of bed #5, clay fills a sharp depression over a region where the lamination in sand and gravel is bowed downwards (Fig. 3.9). The structure is similar to structures described as hoof prints (Van der Lingen and Andrews 1969), or it may have been produced by frost wedging

The most likely setting in which this part of the sequence formed would be in the northward flowing South Saskatchewan River over towards its west bank. The cross-bedded gravels and sands were transported by swiftly flowing currents which operated intermittently, because the deposition of the thin clay layers would require that there were periods during which the water was more or less stagnant so that clay could settle out. Such conditions are common in the shallower parts of gravel bed streams today. When water levels are high, coarse particles are transported in sediment waves along the bottom of the channel, but as water levels fall, rates of sediment transport decrease and ponds of water are trapped in back-bar areas where clay settles slowly to blanket the coarse sediment. When water levels rise once more, strong particle cohesion limits erosion of the clays so they tend to be eroded as lumps which are incorporated in the sandy and gravelly deposits. The current directions indicated by the sedimentary structures can be used to infer only local transport directions which probably were influenced strongly by the local distribution of sand bars; they cannot be used to indicate regional flows.

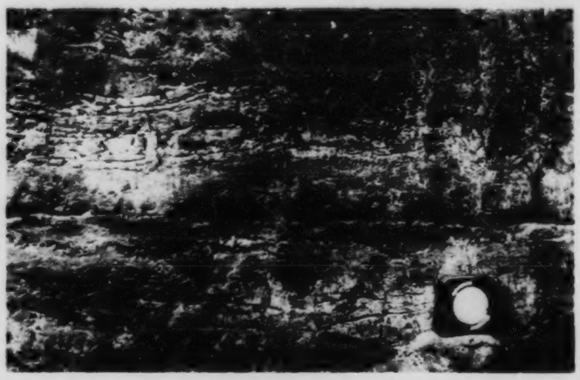


Figure 3.10. Cracked and broken clayey silt layers 230-240 cm above the base of the section (photo by H.E. Hendry).

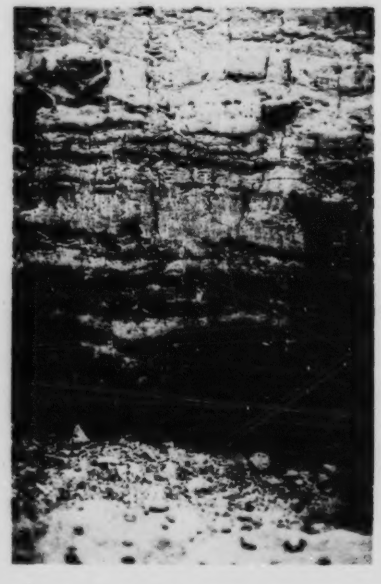


Figure 3.11. Contorted silt layers 150-200 cm above the base of the section (photo by H.E. Hendry).

Stratified silts. Most of the beds in this part of the section are silts. Layering stands out because of variations in the amount of silt and clay through the section. Many of the finer-grained layers are cracked or broken (Fig. 3.10), and most of the layers are uneven and contorted (Fig. 3.11). Some of the sandier layers contain cross-stratification produced by migrating ripples, and the top of bed A6 contains cross-bedding 15 cm thick. Grain sizes range from silty sand to clayey silt. The presence of cross-bedding, particularly that produced by ripple migration, indicates transport by water. The distinct separation of clayey and sandy layers, and the cracked and broken fine-grained layers, suggest periodic wetting and drying. Some of the apparently structureless silty beds could have been deposited by aeolian processes.

Although the grain size is much finer than in the lowermost part of the section, a depositional setting close to the main river, with alternating periods of flooding and exposure, would produce the features seen in this part of the section. It is not possible to say whether the deposits were derived mainly by flow down Sjovold Creek at this site or by flow up from the main channel of the South Saskatchewan River. The contorted layering in this part of the section may have resulted from freeze and thaw of groundwater.

Structureless silts and sands. The uppermost 2.15 m of the section is composed of silts and sands with very little clay, and with no visible stratification, although bedding is picked out by soil horizons (Fig. 3.12). The lack of laminations and clay layers is not typical of water-laid deposits, and the grain sizes of the sediments fall well within the range of material transportable by wind.

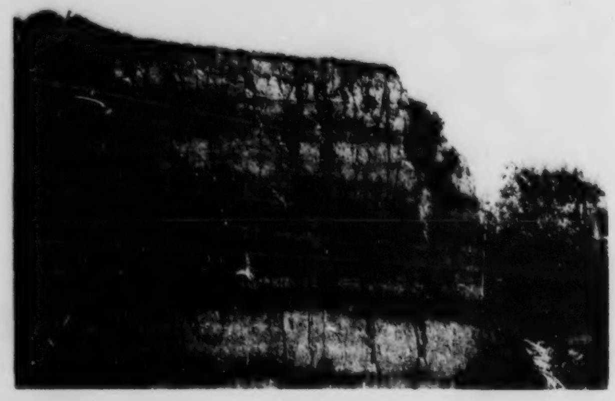


Figure 3.12. Structureless silts and sands forming the top of the Sjovold site (photo by H.E. Hendry).

Soil Environments at the Sjovold Site, by D.W. Anderson and J.G. Ellis

Introduction

Excavations at the Sjovold site encountered several faint to distinct dark coloured layers thought to be buried A horizons of soils. The objectives of this study are to examine the dark coloured layers; to determine whether they are the results of soil formation; to estimate their duration as surfaces; and to research soil properties that might enable substantive statements on the environment of soil formation.

Several methods are used to meet the objectives. Chemical analyses for organic carbon, nitrogen, and total phosphorus provide measurements of the accumulation of organic matter in the dark coloured horizons. Size fractionation by sieving and decantation, followed by microscopic examination of the silt-sized (20-50μ) fraction yield data on grain size distribution as well as revealing the presence of plant opals in the silt fraction. Plant opals are silica bodies of distinctive shapes deposited in the cells of plants, and they are considered to be microfossils of previous vegetation. Data to be compared with values for modern soils are obtained by chemical extraction of the humus in the buried A horizons, characterization of the humus as to humic acid:fulvic acid ratios, and study of the spectral

Table 3.2. Soil horizon designations and percent grain sizes, $CaCO_3$ equivalent, organic matter (OM), total nitrogen (N), and total phosphorus (P).

Cultural Layer	Soil Horizon	Sample	Sand >50μ	Coarse Silt 50-20μ	Med. Silt 20-5μ	Fine Silt 5-2μ	Clay <2μ	$CaCO_3$ Equiv	OM	N	P
Sod	Ah	S20	70.0	23.0	4.0	1.0	1.0	4.3	5.1	0.259	0.094
Sod/I	AC	S19	66.0	27.0	4.0	1.0	1.0	7.6	2.4	0.143	0.084
I, I/II	C1	S18	55.0	39.0	4.0	1.0	1.0	0.0	1.9	0.118	0.083
II	Ahb1	S17	59.0	35.0	3.5	1.0	0.5	10.6	2.0	0.118	0.118
II/III	C2	S16	63.0	32.0	4.0	1.0	0.5	9.3	1.7	0.098	0.079
III	Ahb2	S15	62.0	31.0	4.0	1.0	1.5	9.7	2.8	0.165	0.094
III	C3	S14	58.0	36.0	4.0	1.0	1.5	8.7	2.2	0.116	0.090
IV+V	Ahb3	S11	47.0	46.0	4.0	0.5	2.0	11.2	2.8	0.143	0.090
IV+V	Bmkb	S10	46.0	48.0	5.0	1.0	1.0	10.4	2.2	0.120	0.083
V/VI	C4	S9	52.0	41.0	4.0	0.5	2.5	9.2	1.9	0.113	0.086
VI	Ahb4	S13	41.0	52.0	4.0	1.0	3.0	8.4	1.5	0.086	0.111
VI	C5	S12	56.0	38.0	3.0	0.5	2.5	7.5	1.2	0.071	0.090
VII	Ahb5	S8	46.0	45.0	5.0	1.0	3.5	9.9	1.4	0.079	0.098
VII	C6	S7	40.0	48.0	6.0	2.0	4.0	9.5	1.1	0.066	0.086
VII/VIII	C7	S6	29.0	60.0	6.0	1.5	3.5	10.2	1.0	0.060	0.000
VIII	Ahb6	S5	32.0	57.0	6.0	1.5	3.5	10.1	1.4	0.075	0.090
IX	Ahb7	S3	31.0	56.0	7.0	1.5	4.5	11.5	1.1	0.064	0.098
IX/X	C8	S4	38.0	49.0	7.0	1.5	4.5	11.2	1.0	0.064	0.094
XII	Ahb8	S2	55.0	35.0	5.0	1.5	3.5	7.3	0.7	0.045	0.075
XII	C9	S1	56.0	3.0	5.0	2.0	6.5	7.2	0.5	0.030	0.060
XVII	C	S22	20.0	59.0	13.0	4.0	4.5	12.4	0.5	0.158	0.313
XVII/XVIII	-	S21	14.0	59.0	12.0	4.5	10.0	8.9	2.1	0.038	0.071

properties of the humic acids. These data yield further evidence concerning the relict soil environments. Laboratory work was performed by Nancy Howes.

Table 3.3. Percent plant opal phytoliths in the coarse silt and medium silt fractions.

Cultural	Soil		% Plant opals		
Layer	Horizon	Sample	20-50μ	5-20μ	General shape of phytoliths
Sod	Ah	S20	1.8	1.0	Rods, small irregular, equidimensional
Sod/I	AC	S19	1.4	0.7	Large rods to small irregular rods and fragments
I,I/II	C1	S18	0.8	0.4	Mostly small, some rods, fragments
II	Ahb1	S17	0.9	0.5	Irregular shapes dominant
II/III	C2	S16	0.5	0.6	Rod-like to irregular dumbbell shapes
III	Ahb2	S15	1.6	0.9	Predominantly rods
III	C3	S14	0.8	0.7	Predominantly rods
IV+V	Ahb3	S11	0.9	0.9	Some rods, predominantly small equidimensional
IV+V	Bmkb	S10	0.5	0.5	Rods and small fragments
V/VI	C4	S9	0.3	0.4	Irregular rods
VI	Ahb4	S13	0.7	0.7	Rods predominant
VI	C5	S12	0.9	0.6	Rods and small fragments
VII	Ahb5	S8	0.4	0.2	Rods predominant
VII	C6	S7	0.2	0.2	Irregular, rhomboid pieces
VII/VIII	C7	S6	0.2	0.3	Rod shapes
VIII	Ahb6	S5	0.3	0.3	Irregular rhomboid fragments
IX	Ahb7	S3	0.2	0.2	Small, irregular rods to rhomboid forms
IX/X	C8	S4	0.6	0.2	Irregular rods, dumbbell fragments
XII	Ahb8	S2	0.2	0.6	Irregular rods, fragments
XII	C9	S1	0.3	0.4	[no report]
XVII	C	S22	0.4	0.2	Irregular rods, dumbbell fragments
XVII/XVIII	-	S21	0.4	0.4	Irregular small fragments

Results and Discussion

The characteristics of the layers sampled as S20, S17, S15, S11, S13, S8, S5, S3, and S2 are indicative of thin, weakly expressed horizons of organic matter accumulation or buried soil Ah (Ahb) horizons (Fig. 3.1, Table 3.2). The most strongly developed buried A horizon encountered in the site is at Layer III (S15). Layer XVII (S22) does not appear to be a soil horizon but rather a fairly continuous ash or hearth layer. Several other ash or hearth layers were delineated by the archaeological study, but these were not included in the study of soil horizons. The weakly expressed soil profiles, with thin Ahb horizons and little or no evidence of the development of B horizons, indicate short periods of soil formation, interrupted by periods when the rates of sedimentation at the site caused burial of former soil surfaces.

The upper portion of the section, above S8, is more sandy than the lower portion (Table 3.2). The sand and coarse silt size classes usually account for more than 90% of the sediment, indicating a well sorted sediment probably of aeolian origin. With increasing depth below S8 the section becomes finer textured, with increasing amounts of fine silt and clay. These sediments may be considered less well sorted and indicate a probable origin as alluvial sediments along the creek. It is possible that there was a major change in the stream course at about the time of deposition of S8, approximately 1,800 years ago.

Table 3.4. Properties of the organic matter in selected dark coloured layers.

Cultural Layer	Soil Horizon	Sample	Property[1]				
			A	B	C	D	E
Sod	Ah	S20	2.63	20	2.8	5.1	1.01
III	Ahb2	S15	1.44	29	3.6	4.6	1.33
IV+V	Ahb3	S11	2.88	33	3.0	5.4	1.04
VI	Ahb4	S13	1.56	40	4.8	4.1	1.24
VIII	Ahb6	S5	1.41	36	4.3	4.7	1.22
IX	Ahb7	S3	1.03	29	11.8	5.0	1.22

1. Properties: A. % organic carbon; B. humic acids as % of total organic carbon; C. humic acids/fulvic acid; D. humic acids E_4:E_6 ratio; E. humic acids E_{280}.

The $CaCO_3$ content of the sediments is relatively constant at about 10% $CaCO_3$ equivalent (Table 3.2). The weathering and leaching of $CaCO_3$ in the modern soil is indicated by the gradual increase in $CaCO_3$ with depth. That weathering and leaching of $CaCO_3$ in the buried soils is not evident may in part be a consequence of downward leaching of $CaCO_3$ into formerly leached zones subsequent to their burial by fresh carbonate-rich sediments.

Those dark coloured layers designated as Ahb horizons generally contain more organic matter and nitrogen than adjacent horizons (Table 3.2). The total phosphorus content of many of these layers is somewhat higher than adjacent layers. It is likely that the higher total phosphorus contents represent slight accumulations of phosphorus in organic form in the soil organic matter, although some additions from phosphorus-rich materials of anthropogenic origin must also be considered. The continuous ash or hearth (S22, Layer XVII) contained much more phosphorus, and slightly more $CaCO_3$, than other layers, supporting its field designation as an ash-rich layer. In general, the organic matter, nitrogen and phosphorus contents of the layers studied are indicative of weakly developed soil Ah horizons, probably of relatively short durations as soil surfaces.

Plant opal phytoliths result from the deposition of amorphous forms of silica in the cells of plants, particularly of grasses. When the plants die and are added to the soil, the organic constiuents decompose and the silica bodies remain. In a sense, they may be considered as microfossils of the plants that grew on the soil at the time of their formation. Detailed studies have indicated their usefulness in identifying plants at the generic level. Most plant opals are of silt size. The highest concentration of plant opals was found in the present-day soil (Table 3.3), with predominantly rod-shaped bodies that are considered indicative of grassy vegetation. Some smaller, more irregular phytoliths of possible arboreal origin were observed as well. Other layers designated as Ahb horizons generally had greater plant opal contents than did adjacent layers, consistent with their existence as former soil surfaces. The opal content of the Ahb horizons was less than the present Ah, suggesting relatively short periods of soil formation on the surfaces. The presence of plant opals in all horizons sampled is considered indicative of the slow rates of accretion of sediment at the site — not rapid enough to bury and kill vegetation — or else an origin of the sediment by the erosion of soils that supported some vegetation and therefore contained some opal phytoliths.

Detailed identification of the opal phytoliths at the level of plant genus was not attempted in this study. However, the smaller size, irregular form and lower proportion of rod-shapes observed in older layers does suggest that early vegetation at the site may have contained less grass and more shrubs and trees than that growing on younger surfaces.

The analysis of the chemical and spectral properties of the soil organic matter (Table 3.4) does not indicate any unusual characteristics as compared to the present-day soil and to properties reported in the literature. There are some differences, particularly the higher proportions of humic acids and the somewhat greater values for the E_{280} parameter, both of which indicate an advanced stage of humification. It is probable that this represents continuing humification with reduced input of organic residues subsequent to shallow burial of the former soil surface. In many ways the buried soil horizons have organic matter properties similar to the B horizons of modern soils.

Summary

The morphological and chemical properties of the dark coloured layers or buried Ah horizons at the Sjovold site are considered indicative of short periods of soil formation on relatively stable surfaces, interspersed with periods of burial by slowly accreting sediments. During early stages, it appears that the sediments were of alluvial origin, with aeolian deposition dominant for the past 1,800 years or so. The characteristics of the soil organic matter and the general nature of the plant opal phytoliths in the soil suggest environments at the times of soil formation which were similar to the present environment. The thin but relatively continuous Ahb horizons indicate only occasional occupation of the site, considering the fragile nature of both the soil and vegetation in the semi-arid climate of the area.

Table 3.5. Radiocarbon dates from the Sjovold site.[a]

Layer	Lab No.	Uncalibrated	Calibrated Age BP 1-sigma	Calibrated Age BP 2-sigma	Calibrated Age BC/AD 1-sigma	Calibrated Age BC/AD 2-sigma
I	S-1757	580 ± 190	690-480	920-280	AD 1260-1470	AD 1030-1670
II	S-1758	730 ± 190	800-540	1000-440	AD 1150-1410	AD 950-1510
III	S-1759	950 ± 190	1060-690	1280-550	AD 890-1260	AD 670-1400
IV-V	S-1760	1320 ± 190	1400-1060	1610-910	AD 550-890	AD 340-1040
IV-V	S-1761	1340 ± 190	1410-1060	1620-920	AD 540-890	AD 330-1030
VI	S-1762	1380 ± 200	1510-1070	1710-930	AD 440-880	AD 240-1020
"VI"	S-1763	1380 ± 190	1500-1090	1700-930	AD 450-860	AD 250-1020
VI/VII	CAMS[b]	1840 ± 55	1860-1710	1890-1690	AD 90-240	AD 60-260
"VII"	S-1764	1630 ± 200	1800-1320	1990-1170	AD 150-630	BC 40-AD 780
"VIII"	S-1765	1860 ± 200	2050-1550	2330-1350	BC 100-AD 400	BC 380-AD 600
"VIII"	S-1766	2710 ± 200	3050-2720	3360-2340	BC 1100-770	BC 1410-390
X	S-1767	2090 ± 165	2330-1880	2430-1700	BC 380-AD 70	BC 480-AD 250
X	S-3366	2190 ± 140	2350-2040	2490-1870	BC 400-90	BC 540-AD 80
X	S-3367	2340 ± 120	2490-2210	2750-2060	BC 540-260	BC 800-110
XI	S-2058	2505 ± 90	2750-2410	2780-2350	BC 800-460	BC 830-400
XI	S-3365	2900 ± 70	3200-2950	3260-2860	BC 1250-1000	BC 1310-910
XII	S-2059	2355 ± 105	2700-2320	2740-2140	BC 750-370	BC 790-190
XIV	S-2060	2500 ± 85	2750-2410	2770-2350	BC 800-460	BC 820-400
XVI	S-1768	2680 ± 165	2960-2720	3220-2350	BC 1010-770	BC 1270-400
XIX	S-1769	3275 ± 160	3690-3360	3900-3160	BC 1740-1410	BC 1950-1210
XX	S-2061	3595 ± 150	4090-3700	4360-3550	BC 2140-1750	BC 2410-1600
XXI	S-2062	3530 ± 115	3980-3690	4140-3560	BC 2030-1740	BC 2190-1610
XXI	S-1770	4130 ± 205	4870-4410	5150-4090	BC 2920-2460	BC 3200-2140
Below XXI	S-1979	4450 ± 240	5450-4730	5720-4430	BC 3500-2780	BC 3770-2480

a. Calibrations determined with the program CALIB (Stuiver and Reimer 1986); b. Average of two measurements (CAMS-2274 and CAMS-2296) from a single collagen extraction.

Radiocarbon Dates

We have obtained 24 radiocarbon dates on samples from the Sjovold site. Fifteen samples (S-1757 through -1770, -1779) were submitted to the University of Saskatchewan laboratory following the 1979 field season (see Dyck 1983: Tables 10.2, 10.4; Rutherford et al. 1984:278-279; slight discrepancies between these sources result from rounding of means and one-sigma limits by the laboratory). Five more samples (S-2058 through -2062) were submitted after the 1980 field season, and three charcoal samples (S-3365 through -3367) were selected for dating during the site analysis in 1991 (Morlan 1993a). We have also made a special effort to learn the age of a very large but unidentified bone found in Interlayer VI/VII (CAMS-2274, -2296). All of the bone dates are based on "soluble collagen extraction" (Brown, et al. 1988; Longin 1971; Rutherford and Wittenberg 1979).

All but two of the 15 samples submitted in 1979 were comprised of bone fragments, and the selection of materials was based on a first approximation of the cultural stratigraphy. In most cases, subsequent analysis has confirmed the original stratigraphy, but three samples originally assigned to Layers VIc, VIIa, and VIIb, respectively, are now seen to have included bone fragments from two or three layers each. These dates are in correct stratigraphic order and are helpful in defining the chronology of the site, but they are not precisely associated with individual cultural complexes.

All of the dates submitted in 1979 have unusually large one-sigma limits (Table 3.5) that resulted from uncertainty concerning the system background at the time the dates were counted (J. Wittenberg, pers. comm. to I.G. Dyck). Therefore the age error calculations performed in 1979 included variables that were not pertinent to the smaller age errors determined in 1980 and 1991. The age errors for the 1979 samples are so large that they fail to resolve the chronology of the site if taken at face value. However, the fact that the means are almost all in correct stratigraphic order shows that the samples had the potential for fairly high resolution. Therefore we propose a site chronology based on the superposition of the stratigraphically ordered layers, the calibrated one-sigma limits of the radiocarbon dates, and interpolations for undated layers (Table 3.6). The dates have been calibrated with the CALIB computer program (Stuiver and Reimer 1986) which often yields one-sigma limits spanning more than one temporal interval. We have adopted these intervals selectively with due regard for the adjacency of stratigraphic layers. Hence the limits shown in Table 3.6 are more restricted than the maximum limits previously published (Morlan 1993a: Table 2), and the resulting chronology generally has a resolution of about three centuries (Table 3.6). The derivation of each age range is explained below.

Layer I, 700-500 BP, AD 1250-1450: based on the one-sigma limits of S-1757 — a date obtained from a bison thoracic vertebra from XU 1 and unidentified bone fragments from XUs 2-3. The sample weighed approximately 250 g. The maximum age of the layer is also constrained by the age range of underlying Layer II.

Layer II, 800-600 BP, AD 1150-1350: older end of this range based on the one-sigma limit of S-1758 — approximately 250 g of large mammal (bison?) bone fragments from XUs 1-3. The younger end of the range is limited by the superposition of Layer I.

Layer III, 1100-700 BP, AD 850-1250: based on the one-sigma limits of S-1759 — approximately 250 g of large mammal (bison?) bone fragments from XUs 1-3.

Layer IV-V, 1300-1100 BP, AD 650-850: range narrowed by averaging S-1760 — approximately 250 g of large mammal (bison?) bone fragments from XUs 1-3 in Layer IV-V — and S-1761 — a similar mass of large mammal (bison?) bone fragments from XUs 1-2 in Interlayer V/VI. The uncalibrated average is 1330 ± 134.4 BP, with calibrated one-sigma limits of 1350-1130 BP (AD 600-820) and two-sigma limits of 1520-970 BP (AD 430-980). The older end of the age range also acknowledges the age of underlying Layer VI. In Chapter 9 we present justification for attributing the Interlayer V/VI materials mainly to Layer IV-V.

Layer VI, 1400-1200 BP, AD 550-750: average of S-1762 — approximately 250 g of large mammal (bison?) bone fragments from XUs 1-3 in Layer VI — and S-1763 — approximately 250 g of large mammal (bison?) bone from XUs 1-2 in Layer VI and from XU 3 in Layer VII. S-1763 was drawn from a planview originally designated Layer VIc. Subsequent analysis showed that the portion of this planview encountered in XU 3 actually belongs to Layer VII. However, the date is identical to that obtained from S-1762, and we consider that an average of these two dates (1380 ± 137.7 BP, uncalibrated) can be applied to Layer VI with calibrated one-sigma limits of 1400-1170 BP (AD 550-780) and two-sigma limits of 1550-990 BP (AD 400-960).

A very large unidentified bone from Interlayer VI/VII has been dated by accelerator mass spectrometry (AMS) to an age several centuries older than the suggested time of occupation. In addition to two dates (CAMS-2274, -2296) on a single collagen extraction, D.E. Nelson also measured the carbon-nitrogen ratio (C/N ratio = 3) and the stable isotope ratio ($\delta^{13}C$ = -19.6‰). The ^{13}C measurement is typical of a terrestrial mammal in C_3 food web (see Chisholm 1989), and the C/N ratio shows that the organic constituents of this bone have undergone little degradation. "In other words, there is reason to believe that [the dated material] is collagen. These are entirely ordinary numbers for this sort of sample" (D.E. Nelson, pers. comm., 24/02/92). The bone represents either a megamammal or an unusual pathology, and we suspect that it may have been acquired by trade. In view of our uncertainty concerning its identity and taphonomic history, we have not considered these AMS dates as constraints on the site chronology.

Layer VII, 1800-1300 BP, AD 150-650: a large age range acknowledging our finding that S-1764 cannot be clearly associated with either Layer VII or Layer VIII. The sample was comprised of approximately 250 g of large mammal (bison?) bone fragments from XUs 1-2 in Layer VII and from XU 3 in Layer VIII.

Layer VIII, 2100-1600 BP, BC 150-AD 350: a large age range acknowledging uncertainty

Table 3.6. Calibrated chronology of the Sjovold site.

Layer	Age BP	Age BC/AD	Data
I	700-500	AD 1250-1450	1 date
II	800-600	AD 1150-1350	1 date
III	1100-700	AD 850-1250	1 date
IV-V	1300-1100	AD 650-850	2 dates, averaged
VI	1400-1200	AD 550-750	2 dates, averaged
VII	1800-1300	AD 150-650	1 date, provenience in doubt
VIII	2100-1600	BC 150-AD 350	1 date, provenience in doubt
IX	2200-1900	BC 350-AD 50	interpolation
X	2300-2100	BC 350-150	3 dates averaged
XI	2500-2200	BC 550-250	1 date (1 date rejected)
XII	2600-2300	BC 650-350	1 date
XIII	2700-2400	BC 750-450	interpolation
XIV	2800-2500	BC 850-550	1 date
XV	2900-2600	BC 950-650	interpolation
XVI	3000-2700	BC 1050-750	1 date
XVII	3200-2900	BC 1250-950	interpolation
XVIII	3500-3100	BC 1550-1150	interpolation
XIX	3700-3400	BC 1750-1450	1 date
XX	3900-3600	BC 1950-1650	1 date
XXI	4000-3700	BC 2050-1750	1 date (1 date rejected)

surrounding the provenience of S-1765 — approximately 250 g of large mammal (bison?) bone fragments from XU 1 in Layer VII, XU 2 in Layer VIII, and XU 3 in Layer IX. The analysis shows that this is the most seriously mixed radiocarbon sample from the Sjovold site. The field data had suggested that the bone fragments were drawn from a planview designated Layer VIIb, but the analysis shows that the plane of this planview lies at an angle to the plane of the actual occupation layers so that three layers were sampled for S-1765. Nonetheless the date is in correct stratigraphic order. Carbonaceous soil from the face of Test Profile No. 2 comprised S-1766. This sample was collected prior to the excavation of adjacent XU 6. At the time, the carbonaceous soil appeared to represent powdery charcoal in hearth fill belonging to Layer VIII, but the excavation during the following field season failed to confirm the presence of a hearth. Although it seemed desirable to obtain a date on a substance other than bone, we do not know how to relate the results to our site chronology.

Layer IX, 2200-1900 BP, BC 250-AD 50: an interpolated age range that allows a century of overlap with the ages of adjacent layers.

Layer X, 2300-2100 BP, BC 350-150: With three concordant radiocarbon dates, this is the most precisely dated layer in the site. The three dates are: S-1767, bison bone from Layer X in Test Profile Nos. 2 and 3; S-3366, 4.1 g of charcoal from a surface hearth (Feature F10-k) in XU 4; and S-3367, 4.5 g of charcoal from a surface hearth (Feature F10-g) in XU 2. They yield an uncalibrated average of 2232.9 ± 79.8 BP with calibrated one-sigma limits of 2340-2140 BP (BC 390-190) and two-sigma limits of 2360-2050 BP (BC 410-100).

Layer XI, 2500-2200 BP, BC 550-250: This range overlaps the one-sigma limit of S-2058 — 290 g of large mammal (bison?) bone fragments from XU 1 (100 g), XU 2 (49 g), XU 4 (69 g), and XU 5 (72 g) — but assumes rejection of S-3365 — 15.8 g of charcoal from a surface hearth in XU 1 (Feature F11-a). These two dates are too disimilar to permit averaging (see Long and Rippeteau 1974). S-2058 has an older mean than the date on underlying Layer XII (S-2059), but the calibrated 1-sigma limits have a broad range of overlap. S-3365 is significantly older than S-2058 (Layer XI), S-2059 (Layer XII), and S-2060 (Layer XIV), failing to overlap with these dates even at two sigma. Therefore, we reject S-3365.

Layer XII, 2600-2300 BP, BC 650-350: This range corresponds closely to the one-sigma limit of S-2059 — 282 g of large mammal (bison?) bone fragments from XU 1 (204 g), XU 4 (24 g), XU 5 (43 g), and XU 6 (11 g). The older end of the range is constrained by adjacency with Layer XIII.

Layer XIII, 2700-2400 BP, BC 750-450: interpolated between two dated adjacent layers, allowing two centuries of overlap in each case.

Layer XIV, 2800-2500 BP, BC 850-550: based on the one-sigma limits of S-2060 — 290 g of large mammal (bison?) bone fragments from a hearth (Feature F14-a) in XU 6 — but allowing for the superposition of Layer XIII.

Layer XV, 2900-2600 BP, BC 950-650: interpolated between dated ranges on adjacent layers.

Layer XVI, 3000-2700 BP, BC 1050-750: based on the one-sigma limits of S-1768 — approximately 250 g of large mammal (bison?) bone fragments from Test Profile No. 4, correlated with Layer XVI.

Layer XVII, 3200-2900 BP, BC 1250-950: interpolation between the age ranges of Layers XVI and XIX, also allowing for adjacency of Layer XVIII.

Layer XVIII, 3500-3100 BP, BC 1550-1150: range derived like that of Layer XVII.

Layer XIX, 3700-3400 BP, BC 1750-1450: derived from the one-sigma limits of S-1769 — approximately 250 g of large mammal (bison?) bone fragments from Test Profile No. 4, correlated with Layer XIX.

Layer XX, 3900-3600 BP, BC 1950-1650: range accounting for both the one-sigma limits of S-2061 — a bison scapula (307 g) from XU 5 — and the ranges given by adjacent dated layers.

Layer XXI, 4000-3700 BP, BC 2050-1750: range favouring S-2062 over S-1770. S – 2062 was comprised of a bison femur (295 g) from XU 5, whereas S-1770 consisted of approximately 250 g of large mammal (bison?) bone fragments collected from Test Profile No. 4 and correlated with Layer XXI. These two dates differ markedly from one another. S-1770 was originally reported to us as 3445 ± 175 BP but was later recalculated to the older age shown in Table 3.5. In view of its peculiar reporting history and its origin in a test profile, we prefer S-2062 as a delimiter on the age of Layer XXI.

Below Layer XXI (S-1979), wood in gravel 307 cm below Layer XXI.

Cultural Stratigraphy

Introduction

As soon as our deep exploratory profiles were exposed it became apparent that the site contained stratified occupation deposits, and we were soon able to discern the gross stratigraphic features. From the surface to a depth of a little more than 2 m was a sedimentary unit comprised of structureless sands and silts containing numerous buried soil horizons and occasional stones, bones and features indicative of human occupations. Below that was another sedimentary unit, about 2 m thick, comprised of stratified silts. It had fewer black horizons, but contained a continuing downward succession of archaeological deposits marked by fire-cracked rocks, chipped stones, broken bones, and the odd feature. At about 4.3 m below surface the second unit ended and was underlain by a third unit of sandy gravels interbedded with clays. We exposed the top meter of the third unit, enough to see that it contained no archaeological remains. Later we learned that it had a total depth of about 5 m. At the time of our excavations the usual level of the creek running just south of our excavations was about 1.5 m below the top of the third sedimentary unit or about 1.75 m below our deepest occupation layer. Each afternoon, around 4 pm, the creek water rose rapidly about 0.75 m as water was released from the Gardiner Dam for downstream uses. Through the evening it would recede to its normal level.

Closer inspection of our deep profiles revealed that the upper two units were apparently formed by a steady, occasionally pulsating, accumulation of sands and silts through flooding, wind deposition and slope wash. In several ways the steady accumulation of fine grained sands and silts simplified our archaeological investigation. The near-horizontal position and fairly clear separation of natural strata meant that a fairly straightforward application of the geological principle of superimposition was possible, while the generally light buff colour of most of the matrix allowed the detection, at least in profile, of some subtle internal stratigraphic markers. Although archaeological remains were only moderately abundant in the profiles, they stood out clearly, and we found that extrapolating their alignments into horizontal zones was not too difficult. At an early stage we were able to make a provisional identification of 21 occupation layers. According to our working definition, an occupation layer was a distinct, roughly horizontal zone (usually about 3-6 cm thick or somewhat more if the artifacts were larger), which contained artifacts and/or features, and which was bounded both above and below by deposits containing no features and few or no artifacts. When layers were either thicker than 10 cm or else grouped so closely together that keeping them separate during excavation would be difficult, we made allowance for sublayers.

Identifying Occupation Layers

Every buried soil horizon contained an occupation. However, there were also occupation layers situated between buried soils and in parts of the section where no buried soils were found. We would have preferred to have excavated strictly according to occupation levels, but we encountered several practical difficulties in recognizing the tops and bottoms of occupation layers. Sometimes there would be several markers in one part of our exposure and none in another part only a short distance away. Presence or absence of artifacts was our main reference but, since we expected that some areas of occupation could be sparse or even devoid of artifacts for cultural reasons, we were constantly left to wonder whether a particular sparseness or absence of artifacts was due to an absence of occupation, to dipping or a depression of the occupation surface, or to the nature of occupation itself. We often felt blind in areas where we thought we should have been within the occupation zone but had too few points of reference to make a decision. Encountering artifacts where we thought there should be none was another kind of difficulty. We expected that presence/absence would be a much stronger indicator of being inside or outside an occupation layer than it actually was. Time after time, after having exposed, planviewed and then lightly trowelled through what we thought was the bottom of the layer, we found that artifacts did not stop appearing until we were clearly well beyond the bottom of the layer and practically into the next one. Sometimes, especially in cases where the interlayers were thin, the artifacts continued until we were definitely into the next layer.

Our method for coping with such uncertainties was to increase our records — more excavation levels, more planviews, more photographs and notes — in the hope that we would be able to sort out problematic associations in later analysis. After completing such analyses we were gratified to find that much of the uncertainty was resolved and that the rough cultural stratigraphy worked out in the field had largely been confirmed with only a few differences. In order to make those differences clear we have used Roman numerals to identify layers in this final report. Readers are advised to be on the alert when referring to the arabic numbering scheme used in field reports and in earlier publications concerning radiocarbon dates. In one or two cases the field sublayer assignment has been moved up or down or has been grouped in another way. In one case a sublayer has been assigned to a different layer. In another case analysis has shown that a bone attributed in the field to Layer XIX and used for a radiocarbon date was actually quite certainly seated in Layer XX. A table showing the relationships between field excavation levels, artifact catalogue numbers, and final layer assignments is provided in Appendix 1.

Description of Occupation Layers

The cultural stratigraphy, derived from both observation during excavations and from subsequent analyses of excavation records and collections, is illustrated in Figs. 3.13-3.15. The contents of occupation layers and relatively sterile interlayers are summarized in Table 3.7. Descriptions of depth and slope make reference to a datum at 2n2w through Layer XII and at 0n2w below Layer XII.

The Sod. The modern topsoil, or sod, comprises a 3 to 7 cm thick Ah horizon of sandy soil capped and bound together by prairie grass. The development of an Ah horizon indicates that the site's present surface has been stable, at least along the apex of the ridge, for some decades if not longer. In the interests of speed we disposed of the sod without screening and therefore have little record of what it contained. In grassy areas within 150 m of our excavations to the north, south and west, the surface bears scattered evidence of activities such as wagon and automobile traffic (abandoned road/trail bed), beer drinking (broken bottles and hearths), picnicking (stone-ringed hearths, wiener sticks), boy scout camping (collapsed wooden observation towers, the remains of a post-in-ground bench and small earth filled pits), all of which seem to date to the past 50 or 80 years.

Although our excavation area was peripheral to most of these remains, there was one small feature in the midst of the area we chose to investigate. It was the remains of an archaeological test pit excavated by Ralph and Leslie Sjovold during the early 1960s. Situated on the crest of the ridge about 2 meters from the brink of the creek bank, their partially backfilled pit appeared, in 1979, as a shallow irregular depression about 1.5 m N-S by 1.0 m E-W with a low pile of dirt adjoining on the east. Most of the pit fell into our unit 0n0w but small parts projected into units 0n2w and 2s0w. It turned out that the brothers had excavated to about 0.8 m below surface (to Cultural Layer V) and had backfilled with perhaps three quarters of the removed earth. Included were a few pieces of brown and of clear bottle glass, a metal button, a 30.06 brass shell casing, plus potsherds and broken bone and stone indicative of aboriginal occupations.

Layer I, beginning about 17 cm below surface (BS) at 2n2w, was associated with the base of the AC and top of the C1 soil horizons (Table 3.2). It contained neither a clear living floor nor features, and the bulk of its artifacts (Table 3.7) were scattered through a vertical distance of about 3-6 cm. A radiocarbon date indicates that occupation occurred between AD 1250 and AD 1450 (Table 3.6). The Sjovold brothers' test pit lay mainly in the southeast quarter of XU 1. It penetrated through Layer I and the underlying interlayer.

Layer II began about 33 cm BS at 2n2w, averaged about 5 cm in thickness, and was coincident with a buried soil horizon labelled Ahb1 (Table 3.2). The part of the occupation surface we exposed was roughly horizontal between 2n0w and 2n4w but farther west sloped sharply downward at the rate of about 17:200. The north-south slope was downward at about 8:275. We found four features and a variety of artifacts including Wascana Ware potsherds representing two to four vessels (Table 3.7).

Figure 3.13. South-facing profile of XUs 1-3 (top) and the upper portion of XUs 4-6 (bottom), showing occupation layers I-XIV. RSM #EiNs-4:80-330 CT.

Figure 3.14. Sjovold site cultural deposits from Layer I to Layer XXI in the west-facing profile of XU 4. RSM #EiNs-4:80-335 CT.

A radiocarbon date on bone indicates that the occupation represented by these remains occurred between AD 1150 and AD 1350 (Table 3.6). The bulk of Layer II material lies within the 5 cm thick Ahb1 soil horizon (Table 3.2), but there was a substantial trace of similar material found in diminishing quantities up 10 cm or more below. Ceramics tie much of the Interlayer II/III material to Layer II. Animal burrowing in the zone between layers I and IV in the east half of XU 1 probably contributed to the downward drift of cultural materials in that area. Disturbance on the edges of the Sjovold test pit in the southwest quarter of XU 1 accounts for the downward displacement of materials in that area. The downward displacement in other areas may have been due to factors such as trampling, and passage through root canals and desiccation cracks.

Layer III contained two occupation levels. Layer IIIa, situated 45-48 cm BS at 2n2w, was coincident with a dark brown, strongly developed, buried soil horizon labelled Ahb2 (Table 3.2). This occupation surface sloped upward from datum very gently to the east (5:200), downward gently to the south (10:340), and downward strongly to the west (25:400). On the downslope west of 2n3w the soil horizon became faint, diffuse and difficult to define. Artifacts in Layer IIIa were very sparse, and features were absent. Layer IIIb, situated 50-55 cm BS at 2n2w, was coincident with a diffuse grey-brown buried soil horizon labelled C3. The slopes on this layer were roughly parallel to those of Layer IIIa. Slight undulations in the surfaces of IIIa and IIIb brought the two occupations a little closer together at some places and a little farther apart at others. At places where separation was greatest or where definition of soil horizons was sharpest, there was usually also a 1-3 cm thick lens of buff grey deposit between the two occupation/soil horizons, but in other places they tended to merge. We tried to excavate Layer III as two occupation layers, but a combination of difficulties precluded clear separation — slope, artifact sparseness in Layer IIIa, variable amounts of stratigraphic separation and compression across the layers, and faintness of contrast between the buried soils and the enclosing deposits in some places. Although we were able to obtain some subsamples with fairly certain Layer IIIb associations, all samples containing Layer IIIa materials are suspected also to contain Layer IIIb materials, probably in large proportion. Our exposure of Layer IIIb revealed a cluster of five features and a large assemblage of artifacts (Table 3.7). We suspect that the materials belong to the Moose Jaw complex. A radiocarbon date on bone indicates an age for the occupation in the range of AD 850-1250 (Table 3.6).

The Sjovold brothers' test pit penetrated Layer III and the underlying interlayer in the southwest quarter of XU 1. There was a extensive horizontal burrow about 5-10 cm in diameter in the southeast quarter of XU 1. It was partially infilled with buff-brown sand/silt. In an least three places the burrow widened and deepened to form globular chambers about 25 cm in diameter. These connected with a 15-25 cm wide, loosely infilled, near vertical burrow in the NE corner of XU 4. It extended from the modern surface to Layer VI. There was also a loosely infilled north-south oriented horizontal burrow on the north central edge of XU 4. It was about 15 cm in diameter and may have been part of the same burrow system. There were indications of other burrowing in XU 3, but the diffuseness of soil colours made definition difficult. In addition, the vertical diffusion of dark brown and grey-brown colours of Ahb and C horizons indicate that diagenetic processes such as ground water percolation, freeze-thaw, or insect burrowing may have been at work. Interlayer III/IV, situated 55-63 cm BS at 2n2w, was a buff-coloured deposit of sandy silt.

Layer IV-V. During initial stages of excavation we identified two cultural horizons at 70-80 cm below surface and labelled them layers 4 and 5. Subsequent research led us to the conclusion that these comprised only one occupation layer. That realization crystallized so late, however, that renumbering the cultural sequence could have created confusion since preliminary reports had used the original layer attributions (Dyck 1983; Rutherford, et al. 1984). Rather than appearing to have a missing layer, we decided to refer to materials from the old layers 4 and 5 as Layer IV-V.

Occupation Layer IV-V was situated 70-79 cm BS at 2n2w and coincided with two buried soil horizons (Table 3.2). Ahb3, the old Layer 4, was a diffuse dark brown horizon extending from 70-75 cm BS. It contained an occupation surface, two features, and a substantial quantity of cultural debris. This is the heart of Layer IV-V. Immediately below was Bmkb, the old Layer 5, a faint grey-brown horizon extending from 75-79 cm BS. That zone was penetrated by a pit feature originating in Ahb3 and contained traces of chipped stone (including one well-made Prairie Side-notched projectile point), coarse rock and bone debris, apparently all derived from the Ahb3 occupation zone. The slopes of Layer IV-V paralleled those of Layer III, except for a negligible north to south slope. The Sjovold brothers' test pit penetrated to the bottom of Layer IV-V mainly in the southwest quarter of XU 1. Animal burrows were evident in the east half of XU 3 (up to 25 cm diameter), the northeast quarter of XU 2 (up to 20 cm diameter), the southeast quarter of XU 1 (up to 17 cm diameter), the northeast quarter of XU 4 (a 15-25 cm wide, loosely infilled, near vertical burrow extending from the modern surface to Layer VI in the NE corner), and the southeast edge of XU 4 (a vertical, infilled burrow up to 30 cm diameter from the modern surface to the base of the Ahb4 horizon of Layer VI). There are two radiocarbon dates for Layer IV-V: one from the Ahb3 zone yielded a calibrated age in the range of AD 550-890 (S-1760); the other, from Bmkb, yielded a calibrated age in the range of AD 540-890 (S-1761, see Tables 3.5-3.6). Interlayer V/VI extended from the bottom of Layer IV-V to the top of Layer VI. It was about 9 cm thick, comprised of buff/grey sands and silts, and contained artifacts representing mainly Layer IV-V but also Layer VI (see Chapter 9).

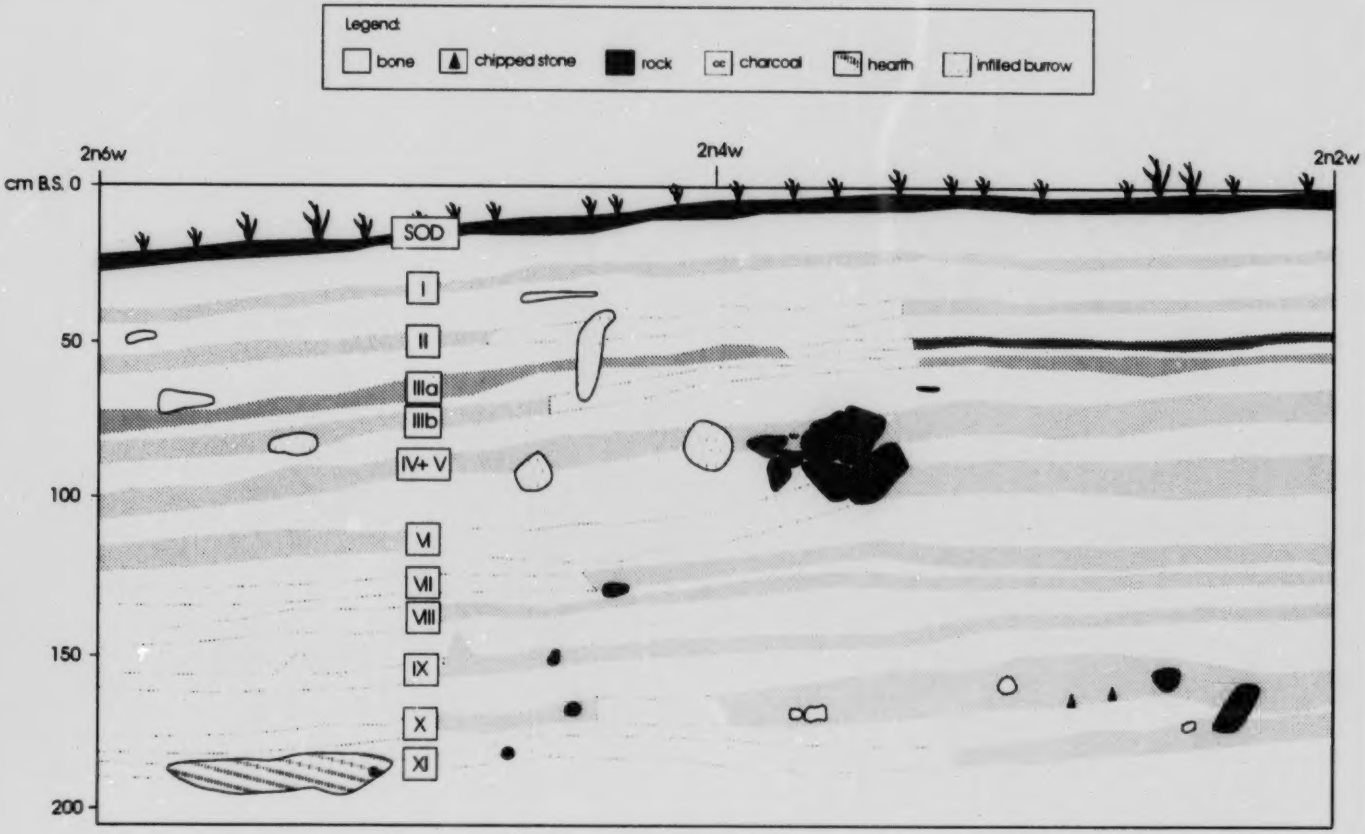
Layer VI was situated 88-101 cm BS at 2n2w. The occupation coincides with the base of a diffuse, intermittent grey-brown buried soil labelled Ahb4, and the body of an underlying buff-grey, white-speckled, sandy silt horizon labelled C5 (Table 3.2). Five features were found at the base of the Ahb4 horizon or, where the Ahb4 horizon was imperceptible, in an equivalent position. Artifacts diagnostic of the Avonlea complex together with rock, chipped stone, and bone debris extended throughout the C5 horizon. From a high point at 2n0w to 0n0w the occupation surface was essentially flat, and from 0n0w to 1.75s0w it sloped downward (toward the creek) at a rate of about 27:175. Similarly, the surface was flat from 2n0w to 2n3w, and sloped downward from 2n3w to 2n6w at a rate of 35:270. Two samples of bone provided radiocarbon dates in the range of AD 550-750 (Tables 3.5-3.6). The broad base of an infilled, vertical animal burrow reached to the bottom of the Ahb4 soil horizon in the northeast corner of XU 4, continuing from Layer IV-V. An infilled, east-west oriented burrow, some 25 cm in diameter, extending from a few cm above Layer VI to the middle of Layer VII, was also in the NE corner of XU 4. Interlayer VI/VII is about 13 cm in thickness and is comprised of buff/brown sandy silts containing artifacts from layers VI and VII.

Layer VII lay about 114-121 cm BS at 2n2w and coincided with an intermittent diffuse dark-coloured layer labelled Ahb5 and the top of the underlying buff-coloured C6 horizon (Table 3.2). Four features were exposed along with a substantial amount of occupation debris (Table 3.7), scattered through a vertical depth of about 7 cm, from the top of the Ahb5 horizon to about 3 cm below. The archaeological identity is considered to be intermediate between Avonlea and Besant, possibly an example of Samantha (Kehoe 1974). The occupation sloped downward east to west across the excavated area at a rate of about 17:600. The north to south slope was downward at about 7:375. There was an infilled, apparently horizontal, east-west burrow straddling layers VI and VII in the northeast corner of XU 4. A radiocarbon date on bone indicates an age between AD 150 and AD 650 (Table 3.6). Interlayer VII/VIII extended about 121-124 cm BS at 2n2w and coincided with buried soil horizon C7.

Layer VIII lay 124-130 cm BS at 2n2w, on and under a very faintly developed horizon labelled Ahb6 (Table 3.2). In XUs 2 and 5, the Ahb6 horizon was so faint as to disappear into the surrounding buff-coloured matrix. Determining the vertical position of Layer VIII in such areas was extremely difficult and relied mainly on extrapolation from adjoining units. Layer VIII seemed to have a high point at about 2n1w from which it sloped downward at about 17:500 toward the west and about 5:400 toward the south. The slope increased at the west side of excavations. Only one feature was found, and the sparse scattering of occupation debris did not include diagnostic tools. A radiocarbon date on bone indicates that occupation took place between 150 BC and AD 350 (Table 3.6). The underlying interlayer, VIII/IX, consisted of buff-coloured sands and silts extending about 130-135 cm BS at 2n2w.

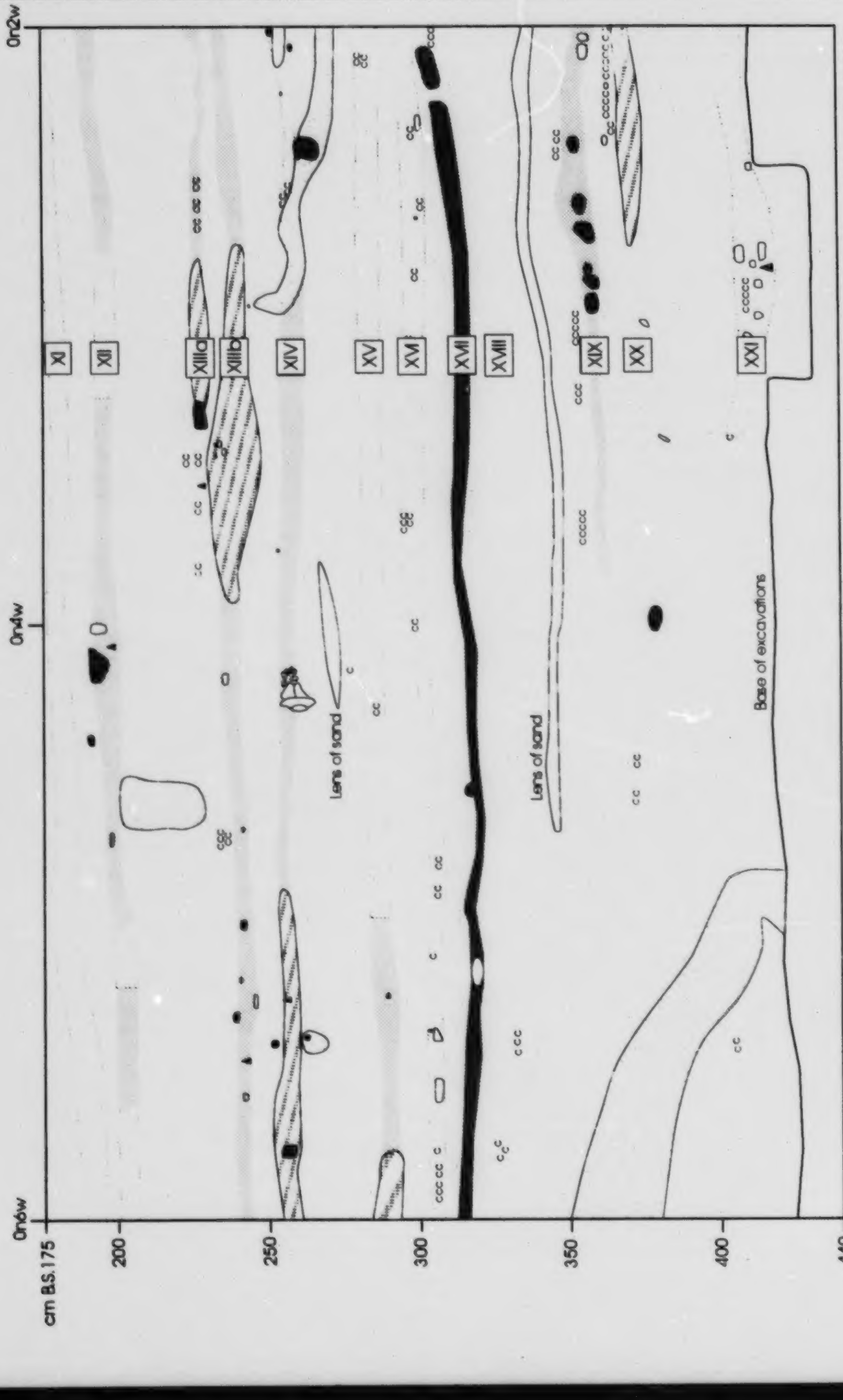
Layer IX, another culturally unidentified occupation, lay between 135-141 cm BS at 2n2w. It coincided with a very faint, intermittent, buried soil labelled Ahb7 (Table 3.2). Three features were exposed in this layer, and occupation debris included a fair amount of finely broken chipped stone and comminuted bone (Table 3.7). The occupation surface sloped downward from 2n2w to the west at about 17:400. The north-south slope was difficult to detect. The age of Layer IX, interpolated from dates in layers above and below, is between 350 BC and AD 50. Interlayer IX/X, about 11 cm in thickness, was excavated in two levels. In subsequent analyses we apportioned the artifacts between the two adjacent layers, upper level artifacts to Layer IX and lower to Layer X, and we distinguish no interlayer artifact record in this report.

Layer X, a Besant/Pelican Lake occupation, lay 152-165 cm BS at 2n2w. This layer was one of two for which we had simultaneous controlled exposure covering both "0" south and "2" south rows of excavation units, a total of about 23 square meters. The exposure contained 12 features and a large artifact assemblage (Table 3.7). The large number of cobbles, small boulders, and pieces of coarse rock was unusual. Another layer characteristic was surface and base undulations, some of which had


Legend:
bone
chipped stone
rock
charcoal
hearth
infilled burrow
2n6w
2n4w
2n2w
cm B.S. 0
50
100
150
200
SOD
I
II
IIIa
IIIb
IV+ V
VI
VII
VIII
IX
X
XI

Original drawing by JP, OK, DWM, SM, KE and ID; Corel rendition by ID.

Figure 3.15. Stratigraphic profile of occupation layers in the Sjovold site.


0n2w
0n4w
0n6w
cm B.S.175
200
250
300
350
400
440
XI
XII
XIIIa
XIIIb
XIV
XV
XVI
XVII
XVIII
XIX
XX
XXI
Lens of sand
Lens of sand
Base of excavations

Original drawing by JP, KE, SM and ID; Corel rendition by ID an amplitude of as much as 8 cm over a span of as little as 75 cm. From a high point at 2n2w the layer sloped downward to the west at about 21:400. To the south the slope was more gentle, about 1:100. The enclosing sediments continued to be buff, yellow-grey sands and silts, and their lack of differentiation within the layer made exact location of the top and bottom of the occupation quite difficult. In some places our profiles revealed a faint dusty grey colour marking the top of the layer, designated C8 in Table 3.2, but elsewhere the occupation blended imperceptibly into interlayers above and below. There are three radiocarbon dates, two on charcoal and one on bone, which indicate an age of occupation between 350 BC and AD 150 (Tables 3.5-3.6).

It was very difficult to determine where the bottom of Layer X was situated. A 1-10 cm thick zone (excavation levels 10-6, 10-7) which we thought would be Interlayer X/XI turned out to contain new features that we were very surprised to see. A true interlayer should not contain such features. Possible explanations might be that: (1) the features were in a trough in Layer X; (2) they were on the crest of an undulation in Layer XI; or (3) they represent a phase of occupation separate from layers X and XI. There were no diagnostic artifacts in direct association with the "interlayer" features to resolve this question. Comparisons of chipping debris and radiocarbon dates also left us with equivocal results. However, one match among faunal remains of interlayer feature F10-e with those of Layer X feature F10-i makes it appear that interlayer features in that area belonged to Layer X. Meanwhile, stratigraphic evidence (mainly extrapolated depth) has been used to assign an isolated feature in XU 6 to Layer XI. Thus, Interlayer X/XI remains have been apportioned to layers X and XI.

Layer XI lay 169-178 cm BS at 2n2w. For the most part, the occupation matrix could not be distinguished from the enclosing deposits except by cultural materials. There were, however, places where a very faint grey soil colour was combined with cultural evidence marking the layer for distances of a meter or more. Layer XI was the second case in which we exposed a 23 square meter area at one time, revealing nine features and a substantial amount of occupation debris including distinctive convex-based projectile points to which we have given the type name "Bratton" (Table 3.7). Most occupation remains were in the top two-thirds of the layer. Layer XI sloped downward to the west and southwest from a high point at 2n2w at a rate of about 1:26. To the east and southeast the slope was much gentler. An infilled animal burrow, horizontal and about 8 cm in diameter, penetrated the south side of hearth F11-f from the southeast in XUs 4 and 5. Two radiocarbon age assessments on Layer XI yielded contradictory results (Table 3.5). We accept the date which falls between estimates for layers immediately above and below and reject the other. This yields an age in the range of 550-250 BC (Table 3.6). Interlayer XI/XII ranged from 2-7 cm in thickness and consisted of buff-coloured sandy silts. We excavated it in two levels and later merged materials from the top portion, our excavation level 11-4, with the materials of Layer XI, while those from the bottom, level 12-1, were merged with Layer XII.

Layer XII lay 185-192 cm BS at 2n2w and was coincident with a diffuse grey-black zone identified as buried soil Ahb8 (Table 3.2). In 15 m^2 of exposure we uncovered six features and a modest amount of surrounding occupation debris (Table 3.7). From a high point at 2n2w the layer had a gentle downward slope to the west (1:40) and to the south (1:40) toward the creek. East of 2n2w the occupation surface was level to the limit of excavations. Two segments of an infilled horizontal animal burrow were observed in the middle of XUs 4 and 5. Two vertical animal burrows were intercepted toward the center of XU 6. Thus, animal burrowing may account for the penetration of some cultural debris beneath the layer. A couple of Layer XII hearths also carried material into the interlayer. Materials from the upper 5 cm of the interlayer have been included in the Layer XII analysis. A radiocarbon date on a bone sample indicates that occupation occurred between 650 and 350 BC (Table 3.6).

Between layers XII and XIII was a 32 cm deep deposit containing a small quantity of cultural remains. The upper body of Interlayer XII/XIII is comprised of about 18 cm of buff sand. A little more than midway through the interlayer, about 210-215 cm BS at 0n2w, there was a barely recognizable horizon of slightly coarser buff sand within the increasingly silty deposits of the section. Coincidental with this horizon was a smattering of large bones and bone fragments together with a few rocks. It is uncertain whether this was a primary or a secondary deposit, and we have not given it a separate label. Beneath that was a 15 cm thick continuation of buff silts and sands comprising the bottom of Interlayer XII/XIII. An infilled animal chamber, about 27 cm in height by 16 cm in width, was observed at the top of the interlayer in the northeast quarter of XU 6.

Layer XIII was comprised of two sublayers. Layer XIIIa, a sparse intermittent occupation of unknown cultural affiliation, lay 224-230 cm BS at 0n2w, coincident with the lower part of Sedimentary Bed A8 (Fig. 3.1). For the most part it was distinguished from the enclosing sandy silt deposits solely by cultural remains, comprising one small surface hearth and a sparse scattering of charcoal, chipped stone, bone fragments and pieces of coarse rock. We were not forewarned about the presence of sublayer XIIIa by any evidence in the nearby deep profile and therefore were surprised to encounter its remains a few centimeters above the level at which we expected Layer XIII. Since it was so thin we pressed the excavations a little deeper where we found the Layer XIII materials we were expecting. It was only after we had passed through what turned out to be sublayer XIIIb that we could see the full profiles of two hearths, one immediately above the other, marking two separate phases of occupation. As a result, though we can now separate the Layer XIII sublayers in profile, we cannot separate all the artifacts. Fortunately, some key artifacts are known with certainty to have been located in XIIIb. Infilled horizontal and vertical animal burrows, 6-9 cm in diameter, were noticed at several locations in sublayer XIIIa.

Layer XIIIb was distinguished from the enclosing buff-coloured silts and sands primarily by cultural remains that were somewhat more abundant than in XIIIa. Beginning about 235 cm BS and continuing to about 240 cm BS at 0n2w, XIIIb lies within Sedimentary Bed A7 (Fig. 3.1), a mixture of unstructured silts and fine sands. XIIIb contained two features and a modest sample of artifacts. Material within the hearths extended as much as 10 cm below the occupation surface indicating fairly intense use. Layer XIIIb was nearly flat, with a gentle downward slope from a high point at 0n0.75w toward the west at 11:525 and south at 7:200. However, there appeared to be some gentle hollows on

Table 3.7. Cultural layers by area, volume, content, and archaeological complex or point type.[a]

Layer	XUs	Area (m^2)	Volume (m^3)	Fea- tures	Coarse Rock	Pot- sherds	Stone Tools	Chips, Cores	Bone Tools	Vertebrate Remains[b]	Complex or type
Sod	1-6	23.0	1.1	-	-	-	-	-	-	-	modern
Sod/I	1-6	23.0	2.8	-	-	-	-	-	-	-	-
I	1-6	23.0	2.8	-	38	4	4	23	-	308	unidentified
I/II	4-6	12.0	1.1	-	5	-	-	6	-	65	-
II	1-6	23.0	1.2	4	97	321	3	45	2	240	Moose Jaw
II/III	1-6	23.0	1.6	-	16	113	-	7	1	72	-
III	1-6	23.0	4.0	5	339	13	20	1,452	7	1,570	Moose Jaw
III/IV	1-3	12.0	1.7	-	3	-	3	324	-	111	-
IV-V	1-6	23.0	3.2	2	141	1	10	96	4	640	Prairie s-n
V/VI	1-3	12.0	1.4	-	10	8	1	20	-	67	-
VI	1-6	23.0	4.4	5	565	917	9	228	1	1,273	Avonlea
VI/VII	1-3	12.0	1.6	-	76	44	4	120	-	305	-
VII	1-6	23.0	1.8	4	527	28	17	180	-	1,360	Samantha/ Avonlea
VII/VIII	1-3	12.0	0.4	-	14	2	-	44	-	266	-
VIII	1-3	12.0	0.7	1	51	-	3	59	1	37	unidentified
VIII/IX	1-3	12.0	0.6	-	44	-	1	203	-	194	-
VIII+IX	4-6	11.0	3.1	-	393	-	2	682	-	901	mixed
IX	1-3	12.0	1.3	3	157	-	4	791	1	307	unidentified
X	1-6	23.0	4.0	12	1,142	-	38	695	1	4,187	Besant/Pelican Lake
XI	1-6	23.0	3.2	9	2,852	-	35	505	1	2,889	Bratton type
XII	1,4-6	15.0	1.5	6	235	-	5	41	-	414	Sandy Creek type

Table 3.7 (continued)

Layer	XUs	Area (m^2)	Volume (m^3)	Fea-tures	Coarse Rock	Pot-sherds	Stone Tools	Chips, Cores	Bone Tools	Vertebrate Remains[b]	Complex or type
XII/XIII	4-6	11.5	3.6	-	89	-	2	17	-	194	-
XIII	4-6	11.5	1.8	3	622	-	5	348	-	832	side-notched type
XIII/XIV	4-6	11.5	1.4	-	90	-	-	31	-	100	-
XIV	4-6	11.5	1.3	3	877	-	16	210	6	2,595	Outlook type
XIV/XV	4-6	11.5	2.0	1	144	-	1	50	2	631	unidentified
XV	4-6	11.5	0.9	4	413	-	-	43	1	474	unidentified
XV/XVI	4-6	11.5	1.0	-	1	-	-	-	-	-	-
XVI	4-6	11.5	1.0	2	19	-	1	1	-	150	unidentified
XVI/XVII	4-6	11.5	0.5	-	35	-	-	2	-	256	-
XVII	4-6	11.0	0.6	2	279	-	1	34	2	665	unidentified
XVII/XVIII	4-6	11.0	0.6	-	-	-	-	-	-	-	-
XVIII	4-6	11.0	0.4	-	5	-	-	-	-	3	secondary?
XVIII/XIX	4-6	11.0	3.2	-	-	-	-	-	-	-	-
XIX	4-6	11.0	1.2	7	1,961	-	11	367	6	2,938	Pelican Lake
XIX/XX	4-6	11.0	0.3	-	-	-	-	-	-	-	-
XX	4-6	11.0	0.9	2	17	-	2	3	1	149	Pelican Lake
XX/XXI	4-6	11.0	3.2	-	25	-	-	1	-	326	-
XXI	4-6	11.0	1.2	2	172	-	4	13	1	794	Hanna
Totals			68.6	77	11,454	1,451	202	6,641	38	25,313	

a. Area of excavation is derived from the planviews and includes appropriate reductions for slight inward slope of the walls and for erosion of the creekbank. Volume of excavation is estimated by multiplying the area by the average thickness of each layer. b. Vertebrate remains include bone tool frequencies.

the surface, particularly near the high point. A small amount of animal burrowing was evident in XU 6. The age of Layer XIII is interpolated to 750-450 BC (Table 3.6). The underlying interlayer, XIII/XIV, was about 12 cm thick and coincided with the cross-bedded medium-grain sands marking the top of Sedimentary Bed A6 and the top of the Alluvial and Aeolian sedimentary unit (Fig. 3.1). It contained artifacts from the bottom of XIIIb hearths, from the top of Layer XIV, and possibly also from animal burrows traversing layers XIII and/or XIV.

Layer XIV lay 252-263 cm BS at 0n2w, the thickest part of the layer. Average thickness was closer to about 6 cm. Layer XIV lay within and at the bottom of cross-bedded medium grained sands forming the top of Sedimentary Bed A6. In profile the occupation layer was detected mainly by the presence of artifacts, but there was a wispy greyish hue to sands in the vicinity of features and denser clusters of artifacts. Two surface hearths and a patch of reddish brown soil appeared in our exposure. Scattered in and around the hearths were small quantities of stone tools and chipping debitage, and substantial quantities of broken coarse rock and bones (Table 3.7). Layer XIV was occupied by bison hunters who discarded a previously un-named, distinctive style of projectile point. We have given it the name "Outlook Side-Notched," and we interpret the type as being a very early manifestation of the Besant series. A radiocarbon date on bone indicates that occupation occurred between 850 BC and 550 BC. Six rodent burrows, mainly in horizontal orientations, were observed in and under the layer in XUs 4-6.

As we excavated Interlayer XIV/XV, we encountered a sparse scatter of artifacts and part of a small shallow hearth about 8-12 cm below the base of Layer XIV. A few larger pieces of bone were particularly noticeable, but chipped stone debitage and fragmented coarse rock was also present. We believe that these remains were probably in a primary deposit representing a separate occupation but, because of its sparseness, we have not attempted a separate analysis and, lacking diagnostic artifacts, we do not know its archaeological identity. In the excavation profiles we did notice that artifacts attributable to this occupation were enclosed within a thin greyish clay deposit all of which was within the generally buff/grey silts and clays in the middle of Sedimentary Bed A6. The interlayer as a whole, including its phantom occupation, was subject to rodent burrowing, mainly with a horizontal orientation. Interlayer deposits of buff silts and sands continued some 4 cm below the interlayer occupation, to a depth of about 280 BS at 0n2w, and contained small amounts of cultural material, mostly finely broken bone.

Layer XV lay 280-288 cm BS at 0n2w, the surface of the occupation floor being at about 283 cm BS. One small boulder projected upward some 15 cm, but most of the artifacts lay flat on a surface which seemed almost level. There was no perceptible change in the light buff/grey silts and sands of Bed A6 at Layer XV. Four features and some artifacts alone marked the presence of an occupation layer (Table 3.7). The layer contained some chipping debris and a fair bit of fragmented coarse rock and bone, but no chipped stone tools. Consequently, the cultural identity remains unknown. Age is interpolated to between 950 BC and 650 BC (Table 3.6). The top of a large animal den penetrated Layer XV in XU 4, and two small burrows were noticed in XU 5. Interlayer XV/XVI, up to 13 cm in thickness, was a continuation of the silts and sands of Sedimentary Bed A6. The interlayer contained only one small coarse rock fragment.

Layer XVI, an occupation of unknown identity, lay 296-303 cm BS at 0n2w. Most of the cultural material was in the bottom 3 cm. The layer was distinguished by the presence of numerous small pieces of charcoal and a sparse scattering of artifacts. Otherwise, it was difficult to distinguish from the enclosing buff-coloured silt and sand matrix comprising the bottom third of Sedimentary Bed A6. The age of the occupation, based on one radiocarbon date, is estimated at 1050-750 BC (Table 3.6). There were only slight slopes detectable in the occupation floor. From 0n2w, the layer sloped downward to the west at a rate of about 1:50 and downward to the southeast at about 1:80. The large den first seen in Layer XV cut through Layer XVI on the south edge of XU 4 and penetrated as much as 1.5 meters below. Otherwise there did not appear to be much disturbance. Interlayer XVI/XVII varied from 2-10 cm in thickness and contained a few pieces of bone and rock in a matrix of silts and fine sands representing a portion of Sedimentary Bed A6.

Layer XVII, another occupation of unknown identity, began at 307 cm BS and continued to 312 cm BS at 0n2w. Occupation remains lay on and within a 5 cm thick, dark, ashy horizon overlain by a 3 cm layer of buff-grey silts identified by Anderson and Ellis as Soil Horizon C (Table 3.2). Layer XVII and its enclosing sediments lay within Sedimentary Bed A6 (Fig. 3.1). There was evidence for surface firing over almost the whole exposure of Layer XVII. Charcoal, ash, and reddened earth were found throughout. The cultural assemblage included two features, a few artifacts, and a fair amount of fragmented coarse rock and bone (Table 3.7). Throughout our exposure Layer XVII was nearly flat with a very broad gentle undulations. The age of the occupation is interpolated to be between about 1250 BC and 950 BC (Table 3.6). A long branching burrow ran through the north part of XU 6 toward the middle of XU 5. A couple of thick "patches" of yellow-grey silty clay linked by a narrow passage, possibly all one animal den, were situated along the northeast edge of XU 5 and extended along the northwest edge of XU 4. An area of about 850 cm^2 on the south edge XU 4 had been removed by the substantial animal den first encountered in Layer XV and was infilled with buff-coloured sand and silt. Interlayer XVII/XVIII comprised some 5-8 cm of stratified buff and grey-brown silts immediately below Layer XVII.

Layer XVIII comprised a trace of larger bone fragments, a few pieces of coarse rock, and a few chunks of charcoal within disturbed and contorted layers of yellow-buff-grey clay and sand. Though the cultural materials appeared within a fairly thin horizontal zone, there is some doubt that they were in primary context. Layer XVIII extended 317-321 cm BS at 0n2w in a substratum that was slightly greyer than the enclosing deposits. The large animal den noted in higher levels continued though Layer XVIII in XU 4. No other animal disturbance was specifically noted. Interlayer XVIII/XIX was about 28 cm in thickness, consisting of buff-grey silts and sands, and appeared to lack archaeological remains.

Layer XIX, lying between 352 and 363 cm BS at 0n2w, contained the remains of a Pelican

Lake occupation dating to about 1750-1450 BC (Table 3.6). The vertical datum, 0n2w, passed through a shallow depression at the center of a slight crest on the occupation surface. From maximum heights of 348 cm BS at 0n3.25w and 347 cm BS at 0n1.5 the occupation sloped gently downward to the west (at the rate of 7:325), east (4:150) and south (9:325). The greatest depths of occupation, up to 13 cm, coincided with the crest on the occupation surface and were due to intense hearth activities in that area. Average thickness of the layer was about 8 cm. The occupation lay within a deposit of buff-coloured sandy silts, Sedimentary Bed 19, just above the contact with underlying deposits of interbedded silts and clays (Fig. 3.1). In most places the layer was defined solely by the presence of occupation remains since variations in natural soil colour and texture were extremely subtle above, immediately below, and within the layer. Two substantial hearths and several related features, including considerable coarse rock, broken bone, chipped stone debris, and several tools, were exposed in a 11 m^2 area (Table 3.7). Part of a clay-filled animal den, extending almost straight downward from Layer XV, had removed about 1600 cm^2 of the occupation surface along the south edge of XU 4. Similarly, a large sand-filled burrow extending diagonally downward to the east from the northwest corner of XU 6 may have removed a small portion of the occupation surface in that area or may have passed just beneath the occupation. The balance of the exposure bore no perceptible evidence of burrowing. Interlayer XIX/XX, extending 363-366 cm BS at 0n2w, corresponded to Sedimentary Bed 18, a thin horizon of very fine grained sand. It averaged about 4 cm in thickness and contained no cultural material except for odd pieces intruding into it from Layer XX below.

Layer XX is a sparse Pelican Lake occupation which dates between 1950 and 1650 BC (Table 3.6). Occupation remains lay between 365 and 373 cm BS at 0n2w, resting at the base of a thin deposit of buff-brown silt (Sedimentary Bed 17). Cultural debris was our principal guide to the position of the layer. Two small hearths and sparse amounts of bone, coarse rock, chipped stone debris and stone tools were exposed in a 11 m^2 area (Table 3.7). Where debris was absent the occupation level was difficult to locate. It appears that the high point on the surface was about 364 cm BS at 0n0.75w. From that point the surface sloped gently downward (7:350) to the west and south. Underlying deposits of Interlayer XX/XXI (sedimentary beds 15, 16) were about 29 cm in thickness and contained a few items of bone and stone. Part of a clay-filled animal den, which began in Layer XV, passed straight downward through Layer XX removing about 2000 cm^2 of the occupation surface on the south edge of XU 4. In addition, a large sloping sand-filled burrow at the northwest corner of XU 6 removed about 1300 cm^2 of the occupation surface.

Layer XXI, a Hanna occupation dating between about 2050 and 1650 BC (Table 3.6), lay 402-413 cm BS at 0n2w. There were two hearths, a fair amount of coarse rock and broken bone, a small sample of chipped stone debris, and three stone tools found in XUs 4-6 (plus an additional stone tool in an adjoining test profile). Occupation remains were covered by buff-brown clay and rested on an undulating bed of olive-brown clay (Sedimentary Bed 14). Undulations on the occupation surface were most clearly seen in north/south profiles where amplitude ranged from 4-8 cm and distance between troughs from 25 to 50 cm. The most regular troughs ran in waves roughly parallel to the creek bank. A shallow depression in XU 5 contained hearth feature F21-b and much of the occupation debris. It ran northwest to southeast across the general axis of undulation. Another complication was a general east to west surface slope from a high point of 400 cm BS at 0n0w to a low point of 430 cm BS at 0n3w. Beyond 0n3w the occupation was roughly horizontal up to 0n6w. Thus, Layer XXI artifacts with differences in elevation of as much as 20 cm were actually all resting on the same occupation surface. The large animal den on the south edge of XU 4, first encountered in Layer XV, continued through Layer XXI but seemed to be narrowing. It removed a strip of occupation surface amounting to about 800-1000 cm^2 from the south central edge of XU 4. The sloping animal burrow (infilled with sand) seen previously in XU 6 continued downward through Layer XXI where it removed about a 1200 cm^2 strip of the surface along the north central edge of the unit.

Below Layer XXI, clay and silt deposits continued for an additional 20-25 cm and, except for a thin zone immediately below Layer XXI, were barren of cultural remains. At 25 cm below Layer XXI was the top of a massive deposit of alternating layers of gravel, sand and clay. These have been lightly probed but not explored archaeologically in any detail. They appear to represent a phase of river or creek development during which the site was frequently inundated and unsuitable for human habitation.

Chapter 4

Features and Artifacts

Introduction

Having accounted for the matrix and chronology of the Sjovold site in Chapter 3, we turn now to the methods and terminology used in our analysis of the archaeological contents, and to quantitative summaries of the results. In this chapter we are concerned with features and artifacts. Faunal remains are covered in the next chapter. It turns out that rocks and animal bones are the most abundant items recovered during Sjovold Site excavations. According to our analyses, the overwhelming majorities of both materials bear evidence of human use or alteration. Among them, however, are traces of stone and bone which we have identified as separate or unaffected by human occupation, and whose taphonomic histories we have been able to account for in other ways. We also collected moderate amounts of chipped stone debris, stone tools, pottery and charcoal, plus a few bone tools and miscellaneous samples of historic glass and metal objects, eggshells, seeds, ash, soil and feature matrix. Initial analysis and separation of all materials occurred during cleaning, labelling and cataloguing — tasks performed mainly by Dianne Wilson-Meyer for materials from layers I-VII, and by Jean Prentice for other layers. Subsequently, more detailed analyses were undertaken by Ian Dyck (features, rock, stone tools, pottery, chipped stone debris, and historic glass and metal objects), Richard Morlan (bones, bone tools, and eggshells), and R.J. Mott (wood charcoal). The order of presentation in this and the following chapter — features, coarse rock, pottery, stone tools, chipping debris, bone tools, faunal remains — parallels that of later chapters concerned with individual occupation layers (chapters 6-25).

Features

Seventy-seven features were identified in block excavations at the Sjovold site (Table 4.1). An archaeological feature is a special kind of artifact. It is the remains of a human-made physical structure (e.g. hearth, roasting pit, or grave) and/or a pattern of material residues from human activity (e.g. chipped stone debris scattered around a chipping station) which has been preserved in primary archaeological context. A feature marks the place where specifiable kinds of human actions occurred. Although certain elements of a feature may survive excavation, the structure of which they were part usually does not, except in records made by the investigator. Recognition of features is dependent on excavators' methods and experience. For example, a dwelling floor greater than 10 square meters in area is not likely to be recognized in one meter square exposures. Moreover, even if such a feature were entirely exposed by a block of contiguous one meter square units, it might still go unrecognized due to the difficulty of matching equivalent exposure planes in different squares. In general, the more familiar an excavator is with a certain feature type, the more likely he or she is to recognize features of that type. On the other hand, if an excavator is not familiar with a feature type, then that type may escape notice even under optimal conditions of excavation and preservation.

Table 4.1. Features in the Sjovold site[a].

Type	Layer 2	3	4-5	6	7	8	9	10	11	12	13	14	14/15	15	16	17	19	20	21	Total
surface hearth	1	2	1	-	2	-	1	5	5	2	3	2	1	1	-	-	2	2	-	30
extended hearth	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	3
kiln hearth	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
hearth drag	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	3
hearth debris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
blackened earth	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	3
stone anvil	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
rock cluster	1	1	-	-	1	1	1	2	3	1	-	-	-	3	-	-	-	-	-	14
stone boiling ring	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2
debris cluster	2	1	-	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	6
commin. bone clstr.	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
rest area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2
clay patch	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
hide-smoking pit	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	3
shield-making pit	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
rock-filled pit	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
roasting trough	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
post mold	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
Total	4	5	2	5	4	1	3	12	9	6	3	3	1	4	2	2	7	2	2	77

a. No features were defined for layers 1 or 18.

From the beginning of excavations one of our concerns was to create opportunities for recognition and detailed observation of medium and small features (4 m or smaller in greatest dimension). One step in this direction was selection of an exposure of appropriate size and shape. We chose a block composed of three contiguous 2 m x 2 m units arranged in a line parallel to the creek bank on the assumption that, if a concentration of medium and small features existed in this area, then this exposure would give us a fair chance to find them and also see at least part of their surrounding context. In order to facilitate feature recognition in planview, the perspective from which we expected first to see them, we did four things: (1) kept the exposures of all units in a block on equivalent planes of exposure, that is, we exposed all units to the same level at the same time; (2) made the planes of our excavation levels conform as closely as possible to the natural contours of the occupation surface;

(3) made the exposures as smooth and clean as our tools and artifacts left *in situ* would allow, in order to promote the perception of subtle changes in soil colour or texture which might signal the presence of a feature; and (4) tried to make observations on any particular level under the same conditions of lighting and surface moisture so that the observations would be uniform. In addition to descriptive notes, we made planview drawings and took photographs of every excavation level within an occupation layer, and we made additional drawings and photographs of every feature. Features were also sectioned so that sideview perspectives could be recorded.

Although the majority of features were discovered in planview, a fair number were recognized only at later stages of excavation and even during post-excavation analysis. Recognition at a late stage of excavation sometimes meant that the top of the feature and some portion of the body had been obscured by another feature as in the case of a hide-smoking pit within hearth F19-d. The portion remaining after recognition occurred was recorded in detail. The missing part could sometimes be reconstructed from previous records. On a couple of occasions, recognition occurred only after a feature had been entirely transected, but was so situated that it appeared in the profile of the excavation unit. An example is the upper of a pair of superimposed hearths in Layer XIII.

A few of the most interesting feature discoveries occurred during analysis, long after excavations were concluded. Their discovery can best be explained by briefly considering our method for feature analysis. First, we carried analysis of the cultural stratigraphy to an advanced state before attempting feature analysis. With that stratigraphic framework in hand, we listed known features for any particular cultural layer and identified all excavation records which might contain relevant descriptive information. Second, we described the contents, structure and limits of each feature and listed all the possible functions we could imagine. A list of "implications" was drawn up for each of the contending functions and tested against descriptive data assembled for the feature and, if necessary, for the surrounding context. The best fit between "implications" and descriptive data was usually selected as the preferred interpretation.

An interesting aspect of this process was that, having arriving at a preferred interpretation, we were sometimes prompted to look for other features which should have been present if that interpretation was correct. Such searches lead us to the discovery, in excavation records, of a couple of features which we had not seen or, at least, had not recognized during excavations. An example is the roasting trough in Layer XVII. For some layers, artifacts seemed to be in primary context and somewhat arranged, but not in any pattern we recognized as a feature. In such cases we re-examined the records several times in the hope that something might appear which we had previously missed. These searches seldom produced conclusive results, but they did lead to tentative identification of a few features as in the case of Layer XVI. Whether discovered during excavation or in later analysis, all features were given similar descriptive and interpretive treatments, and were included in the final roster only if they were sustained by supportive evidence.

Coarse Rock

After stone tools and chipped stone debris had been removed for separate analysis, a large residual category of rock remained for study. This category included some 11,454 pieces weighing 628 kg (see Tables 4.2-4.3). In contrast to the cryptocrystalline to fine-grained materials found in stone tool and chipped stone debris categories, most of this rock was medium to coarse-grained, although we hasten to add that the category contains a few pieces of cryptocrystalline material. Our analysis shows that much of the coarse rock was fired, presumably in the campfires with which it was often associated. Some specimens show evidence for other possible use such as light pitting, crushing or abrasion. A trivial amount appears to be unused rock which reached the site through non-cultural processes.

Coarse rock was analyzed by excavation level and catalogue entry beginning with considerations of size, weight and material identification. We relied on Rosenfeld (1965) for definitions of rock types and used a combination of Geological Survey of Canada "Prospector's Set of Rock Chips," Geological Survey of Canada "Prospector's Set of Mineral Chips," and the Archaeological Survey of Canada's lithic reference collection for comparisons. Material identifications were based on hand inspections and low power magnification. Given the small size of some pieces, and the absence of systematic observations on mineral components and crystal structure, the identifications should be regarded as provisional. Names and abbreviations for rock types used in this report are: amphibolite (AMP); andesite (AND); anorthrosite (ANR); basalt (BAS); baked clay (BCL); chert, including agate, Swan River Chert and others (CHR); concretion (CON); diabase (DIA); diorite (DIO); dolomite (DOL); gabbro (GAB); granitic-gneiss or grano-gneiss (G-N); gneiss (GNI); granite, including some small angular pieces of biotite and feldspar (GRA); greywacke (GWK); limestone (LIM); mica schist (MSH); mudstone (MUD); peridotite (PER); pyroxene (PYR); quartz porphyry (QPR); quartzite (QTE); quartz (QTZ); rhyolite (RYO); schist (SCH); shale (SHA); slate (SLA); sandstone (SND); silicified sediment (SSD); syenite (SYN); tuff (TUF); and unidentified (UNID).

Beyond size and material, our analysis was designed to distinguish between unmodified rocks and rocks which had been modified through use. Modifications include: (1) adhesions such as carbon smudges, charcoal particles, other dark accretions, and baked clay; (2) unusual colour changes, especially cortical darkening; (3) excessive surface weathering (cracks and friability); (4) disaggregation into blocks or granules; and (5) provenience which indicated an integral association between rock and an archaeological feature. By recording such modifications we expected to be able to identify fire-modified rocks used for boiling or roasting such substances as water, glue, soup and meat. Presence of at least one of the first four types of modification is requisite for an identification as "fire-modified" (cf. Toom and Bauman 1983:13.3; Latas 1992:212; Pagoulatos 1992). We also expected to discover rocks which had been used as props, as small working platforms or anvils, and as weights for holding objects, like hides and tipi covers, tight to the ground. Presence of the fifth type of modification was requisite for that. During the course of analysis we found a few rocks with other sorts of modifications such as regularly chipped edges or extensively chipped faces, clusters of pits

Table 4.2. Number of coarse rocks from the Sjovold site.

	Materials																										
Layers	amp	and	bas	bcl	chr	con	dio	g-n	gab	gni	gra	gwk	lim	msh	mud	pyr	qpr	qte	qtz	sha	sch	snd	ssd	syn	tuf	unid	misc	Totals
I	-	-	1	-	1	1	-	-	-	-	8	-	-	-	-	-	-	-	5	2	-	1	1	-	-	18	-	38
I/II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	5
II	-	-	-	-	1	1	-	-	-	5	59	-	2	-	3	-	-	1	2	-	-	1	-	-	-	22	-	97
II/III	-	-	1	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4	-	16
III	8	3	3	-	3	17	8	-	-	13	115	4	9	-	31	-	-	8	2	13	2	21	8	-	-	70	1	339
III/IV	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	3
IV-V	-	3	-	-	1	-	-	-	1	36	63	-	8	-	1	-	-	5	3	3	-	5	1	-	-	11	-	141
V/VI	1	2	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	1	-	-	-	-	10
VI	-	54	27	-	-	-	-	1	152	40	184	-	37	-	13	1	-	14	2	2	-	29	-	-	-	9	-	565
VI/VII	2	2	1	-	-	-	-	-	1	6	27	-	4	-	4	-	-	11	2	-	-	6	-	-	-	10	-	76
VII	7	9	19	-	-	1	-	39	-	40	180	-	70	-	8	19	-	20	3	-	9	38	1	-	-	63	1	527
VII/VIII	-	2	-	-	-	-	-	-	-	2	3	-	-	-	1	-	-	1	-	-	-	1	-	-	-	4	-	14
VIII	1	1	3	-	1	-	-	1	-	14	19	-	3	-	-	-	-	2	-	-	2	4	-	-	-	-	-	51
VIII/IX	-	1	-	-	1	-	-	-	-	2	30	-	3	-	-	-	-	1	-	-	-	2	-	-	-	3	1	44
VIII+IX	9	8	17	-	1	-	-	109	-	19	83	-	53	3	3	-	-	9	-	-	-	20	-	-	-	58	1	393
IX	3	2	1	-	2	2	-	1	-	17	64	-	16	-	4	-	-	19	3	-	1	4	-	-	-	17	1	157
X	29	58	33	-	2	47	-	12	-	53	485	4	89	51	13	-	3	43	8	1	3	32	30	4	4	134	4	1142
XI	5	31	27	-	3	23	1	515	-	168	1349	3	38	-	4	-	3	132	6	-	2	155	11	1	-	371	4	2852
XII	2	-	4	-	-	1	-	12	-	26	102	14	6	-	-	-	-	18	1	6	-	8	-	-	-	33	2	235
XII/XIII	-	-	2	-	-	-	-	1	-	2	45	-	8	-	-	-	-	4	1	-	-	2	3	-	-	20	1	89
XIII	4	1	16	-	1	-	-	52	-	36	242	-	65	-	-	-	-	63	1	-	-	26	3	1	-	110	1	622
XIII/XIV	-	-	6	-	-	-	-	1	-	3	33	-	11	-	-	-	-	7	-	-	-	-	-	-	-	29	-	90
XIV	3	1	4	-	1	2	-	50	-	84	529	-	31	-	-	-	-	25	-	-	-	53	-	-	-	92	2	877
XIV/XV	-	4	1	-	-	1	-	3	-	11	73	-	6	-	-	-	-	10	1	1	-	3	-	-	-	30	-	144
XV	-	1	-	-	2	-	-	38	-	9	209	1	11	-	-	-	-	4	5	-	-	-	-	-	-	133	-	413
XV/XVI	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
XVI	-	-	-	-	-	-	-	-	-	-	6	-	3	-	-	-	-	2	-	-	-	-	-	-	-	8	-	19
XVI/XVII	-	1	-	-	-	-	-	3	-	-	11	-	1	-	-	-	-	2	-	-	-	-	-	-	-	16	1	35
XVII	-	2	1	-	-	-	-	17	-	22	122	-	14	-	-	-	-	6	-	-	-	1	-	-	-	94	-	279
XVIII	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	1	-	5
XIX	20	88	7	17	1	65	9	241	-	459	694	-	29	5	-	-	4	38	1	-	-	101	-	6	13	161	2	1961
XX	-	3	-	-	-	-	-	1	-	8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	17
XX/XXI	-	-	-	-	1	1	-	-	-	2	14	-	1	-	-	-	-	1	-	-	-	5	-	-	-	-	-	25
XXI	2	-	-	-	-	-	-	48	-	49	26	-	2	-	-	-	2	10	-	-	-	28	-	1	-	4	-	172
Totals	96	277	174	17	22	162	18	1145	154	1126	4789	26	527	59	85	20	12	456	46	28	19	551	59	15	17	1531	23	11454

Table 4.3. Weight of coarse rocks from the Sjovold site.

	Materials																											
Layers	amp	and	bas	bcl	chr	con	dio	g-n	gab	gni	gra	gwk	lim	msh	mud	pyr	qpr	qte	qtz	sha	sch	snd	ssd	syn	tuf	unid	misc	Totals
I	-	-	4	-	4	2	-	-	-	-	1897	-	-	-	-	-	-	-	14	1	-	15	4	-	-	33	-	1974
I/II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	7
II	-	-	-	-	1	1	-	-	-	195	341	-	2	-	3	-	-	68	2	-	-	36	-	-	-	11289	-	11938
II/III	-	-	992	-	-	-	-	-	-	-	154	-	-	-	-	-	-	-	-	-	-	322	-	-	-	14	-	1482
III	86	8	468	-	5	184	13	-	-	1809	1139	254	393	-	19	-	-	321	6	8	440	809	19	-	-	10347	249	16577
III/IV	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3
IV-V	-	5	-	-	67	-	-	-	273	4264	3605	-	267	-	2	-	-	608	255	5	-	285	1	-	-	57	-	9694
V/VI	*	28	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	*	-	-	-	-	30
VI	-	594	2538	-		-	-	73	641	2582	3051	-	382	-	43	61	-	2073	117	1	-	638	-	-	-	125	-	12919
VI/VII	6	249	8	-	-	-	-	-	20	25	216	-	7	-	50	-	-	292	78	-	-	225	-	-	-	11	-	1187
VII	364	26	163	-	-	*	-	773	-	5719	6979	-	1350	-	27	69	-	819	17	-	16	435	*	-	-	180	3	16940
VII/VIII	-	4	-	-	-	-	-	-	-	18	6	-	-	-	2	-	-	1	-	-	-	*	-	-	-	15	-	46
VIII	12	9	1160	-	18	-	-	304	-	3170	1839	-	63	-	-	-	-	81	-	-	345	83	-	-	-	-	-	7084
VIII/IX	-	1	-	-	5	-	-	-	-	113	688	-	17	-	-	-	-	*	-	-	-	69	-	-	-	11	6	910
VIII+IX	213	25	48	-	6	-	-	206	-	2892	12056	-	195	1816	4	-	-	995	-	-	-	347	-	-	-	95	13	18912
IX	6	17	2	-	52	88	-	220	-	2913	6972	-	1108	-	2	-	-	3723	17	-	302	431	-	-	-	31	368	16252
X	515	295	388	-	21	425	-	305	-	3423	149705	124	4545	119	349	-	134	7514	382	*	103	5372	26	36	24	1249	26	175080
XI	408	617	164	-	113	144	380	1127	-	7933	14524	34	890	-	23	-	270	3951	20	-	243	2087	26	8	-	40657	3120	76739
XII	54	-	436	-	-	14	-	1401	-	2192	20256	357	73	-	-	-	-	1990	1	1	-	715	-	-	-	5401	348	33239
XII/XIII	-	-	940	-	-	-	-	13	-	61	697	-	37	-	-	-	-	66	3	-	-	80	1	-	-	78	824	2800
XIII	519	69	1281	-	445	-	-	1139	-	3861	8897	-	296	-	-	-	-	1644	117	-	-	516	15	62	-	7963	760	27584
XIII/XIV	-	-	123	-	-	-	-	22	-	514	1495	-	19	-	-	-	-	233	-	-	-	-	-	-	-	27	-	2433
XIV	1169	1	53	-	410	0	-	7516	-	6057	21944	-	1671	-	-	-	-	1293	-	-	-	3601	-	-	-	223	122	44060
XIV/XV	-	375	1	-	-	59	-	616	-	882	2134	-	773	-	-	-	-	912	2	*	-	22	-	-	-	102	-	5878
XV	-	29	-	-	82	-	-	2994	-	1275	4446	16	17	-	-	-	-	60	12	-	-	-	-	-	-	6228	-	15159
XV/XVI	-	-	-	-	-	-	-	-	-	-	-	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
XVI	-	-	-	-	-	-	-	-	-	-	229	-	4	-	-	-	-	607	-	-	-	-	-	-	-	7207	-	8047
XVI/XVII	-	249	-	-	-	-	-	43	-	-	1492	-	2	-	-	-	-	556	-	-	-	-	-	-	-	43	144	2529
XVII	-	380	114	-	-	-	-	4554	-	2197	7946	-	351	-	-	-	-	1813	-	-	-	5	-	-	-	270	-	17630
XVIII	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	990	-	157	-	26	-	1173
XIX	1981	2704	961	80	1	326	339	11209	-	24018	30744	-	596	436	-	-	975	2753	97	-	-	5385	-	745	595	734	61	84740
XX	-	1701	-	-	-	-	-	477	-	550	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1	2735
XX/XXI	-	-	-	-	55	1	-	-	-	9	608	-	3	-	-	-	-	13	-	-	-	30	-	-	-	-	-	719
XXI	15	-	-	-	-	-	-	2883	-	5369	1267	-	48	-	-	-	797	643	-	-	-	442	-	71	-	85	-	11620
Totals	5349	7386	9844	80	1285	1244	732	35875	934	82041	305331	785	13111	2371	524	130	2176	33029	1140	16	1449	22941	92	1079	619	92512	6045	628120

* weight less than 0.5 g.

or incisions, grooves or areas of polish, and moved them to the appropriate stone tool or chipping debris class. Rocks which showed none of the above modifications were designated unused.

Several ancillary studies were undertaken to enhance the coarse rock interpretations. Lawrence Melit (1982) did a preliminary study of the largest rocks in Layer X in an attempt to discover whether there was any correlation among variables such as rock type, degree of disaggregation, colouration, and rock placement. He was unable to find any significant correlations. Ian Dyck (1990) did a study of coarse rock types in surface exposures adjoining the Sjovold site. The study showed that Sjovold coarse rocks were likely drawn from local sources, and it provided data for comparisons which show certain selectivity in the use of those sources. Elizabeth Moffatt, Conservation Scientist at the Canadian Conservation Institute, studied two fired rocks with black adhesions which we thought might be pitch (Moffatt 1990); the adhering material turned out to be calcium carbonate. Matches of similar material and refits of conjoinable specimens were sought and occasionally found in some layers. This was done on an *ad hoc* basis to answer questions about whether certain features were contemporary with one another. We sorted fired rocks according to size on the assumption that we would be able to establish a correlation between size and degree of disaggregation, and thence between degree of disaggregation and either intensity of use or duration of occupation. Unfortunately, we were unable to establish the necessary correlations and settled on mean weight and comparisons of relative weights by layer as gross indications of intensity of use and/or duration of occupation. For the sake of argument, we have adopted the principle that if a rock sample is more than about 90% fired rock, then smaller mean weight indicates greater intensity of use and/or longer duration of occupation.

Pottery

There were 1,451 pieces of pottery weighing 3,922 g in the ceramic-bearing occupation layers (Table 4.4). Ceramic analysis was aimed at identification and characterization of vessels represented by sherds. Sherds were hand-inspected and often were examined under low power (10x) magnification as well. Observed subjects were colour(s) of surfaces and cores, nature of tempering, texture and gross structure of paste, surface treatment, decorations, encrustations, and vessel part represented by the sherd. Measurements of size and weight were recorded. Names, definitions and abbreviations for vessel parts referred to in this analysis are:

Rim (RIM) — the orifice margin of a vessel; a sherd with surface finish on two faces and an edge.
Neck (NCK) — a constricted zone between the rim and body of a vessel; a sherd with a concave exterior surface and a convex interior surface.
Shoulder (SHL) — the line of juncture between the neck and body of a vessel; a curved or angled sherd with a ridge or elongate convexity along the exterior apex of the sherd and an corresponding concavity on the interior surface.
Body (BDY) — the part of a vessel which lies between the shoulder and the base; or,

when there is no distinct neck (or shoulder), the part of a vessel which lies between the rim and the base; a flat or slightly curved sherd of near uniform thickness.

Base (BSE) — the bottom of the vessel; a gently curved sherd with a slightly convex exterior surface, a flat to slightly concave interior surface, and a marked difference in thickness from one side of the sherd to the other, and often a greater absolute thickness than other sherds of the same vessel.

Crumb (CRM) — a sherdlet or a piece of a sherd whose greatest dimension is less than 1 cm.

Table 4.4. Pottery from the Sjovold site.

	Vessels						unclas-	baked	
Layers	A	B	C	D	E	F	sified	clay	Total
Number of Pieces									
I	4	-	-	-	-	-	-	-	4
II	-	96	223	-	-	-	2	-	321
II/III	-	2	109	-	-	-	2	-	113
III	-	3	2	7	-	-	1	-	13
IV-V	-	-	-	-	-	1	-	-	1
V/VI	-	-	-	8	-	-	-	-	8
VI	-	-	-	781	2	128	5	1	917
VI/VII	-	-	-	3	-	38	2	1	44
VII	-	-	-	2	-	-	8	-	28
VII/VIII	-	-	-	2	-	-	-	-	2
Total	4	101	334	803	2	185	20	2	1,451
Weight									
I	15	-	-	-	-	-	-	-	15
II	-	229	94	-	-	-	6	-	329
II/III	-	3	91	-	-	-	1	-	95
III	-	2	1	3	-	-	1	-	7
IV-V	-	-	-	-	-	1	-	-	1
V/VI	-	-	-	4	-	-	-	-	4
VI	-	-	-	3,303	4	89	6	1	3,403
VI/VII	-	-	-	6	-	21	1	1	29
VII	-	-	-	15	-	19	2	-	36
VII/VIII	-	-	-	3	-	-	-	-	3
Total	15	234	186	3,334	4	130	17	2	3,922

Conjoinable parts of some vessels were recognized *in situ* and were refitted and glued together immediately or shortly after collection. Other pieces were added to these reconstructions during analysis. It turned out that the layers with the largest numbers of sherds entered analysis with substantial portions of vessels already reconstructed. It was a relatively simple matter to identify additional sherds belonging to vessels for which we had partial reconstructions. We did this by matching colour, temper, paste, thickness, surface treatment and decoration. Then, the matching sherds, both conjoined and individual, were classified as to the vessel part they represented. We were watchful for variances in sherds of some critical parts such as rims, necks and shoulders where anomalies in size or shape or decoration might signal the presence of two different vessels of the same type. With the combination of small sample sizes, substantial reconstructions, multiple matching criteria, and vessel part analysis, we feel fairly confident about the vessel assignments. Sherds which could not be matched with partially reconstructed vessels were sorted into groups on the basis of paste, temper, thickness, colour, surface treatment and decoration, and analyzed for vessel parts represented. Each group was assigned to a separate vessel. Sherds which were difficult to classify into one group or another were placed in an unclassified category.

After this process was complete, we compared the vessel groupings in each layer with those in layers above and below and were surprised to find a few matches, on one occasion between layers which were separated by intervening occupation layers. In that case, Layer III, the whole ceramic component of the layer was attributable to source layers above and below. Re-examination of the excavation records showed that the dispersal mechanism was an animal burrow. The dispersed sherds were assigned to their proper vessel and, for interpretive purposes, Layer III became aceramic.

Once the interlayer comparisons were done, an attempt was made to characterize the size, shape, colour, and decoration of each vessel. The results were quite variable depending on the amount of the vessel represented and the degree of reconstruction achieved by refitting. Once the vessels had been characterized, comparisons were made with ceramics from other sites in the surrounding region in an attempt to establish a broader culture-historical significance for our findings.

Stone Tools

Stone objects which show evidence of having been shaped for use as implements (chipped edges, pecked holes, grooves, or drilled holes), and/or showing evidence of use (ground or polished edges or surfaces, or incised edges or surfaces) are classified here as stone tools. Some 201 stone tools were recovered from block excavations and deep profiles at the Sjovold site (see Table 4.5). The classification we have adopted is essentially functional. The categories, for the most part, are deeply rooted in North American archaeology and, although commonly used, are seldom defined. Our definitions, abbreviations, and principal identifying criteria are outlined below.

Abrader (ABR) — a stone used to sharpen, dull, wear away or polish another object by rubbing; a stone which is marked with grooves, incisions or polished facets as a result of use.

Table 4.5. Stone tools from the Sjovold site.

	Tool Types														
Layers	ABR	ANV	AXE	BIF	CHI	CHM	CHP	CSC	ESC	HAM	MUR	PFM	PPT	PRF	SCR	Total
I	1	-	-	-	-	1	-	-	1	-	1	-	-	-	-	4
II	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3
III	-	-	1	-	2	4	-	-	3	-	6	1	2	-	-	19
III/IV	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	3
IV-V	-	-	-	1	-	-	-	-	1	-	5	-	3	-	-	10
V/VI	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
VI	-	1	-	1	-	1	-	-	1	1	3	-	1	-	-	9
VI/VII	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	4
VII	2	-	-	-	-	-	-	-	5	1	7	-	2	-	-	17
VIII	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	3
VIII+IX	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	2
VIII/IX	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
IX	-	-	-	1	-	-	-	-	1	-	-	1	1	-	-	4
X	-	-	-	2	-	-	1	1	10	-	12	3	6	3	-	38
XI	-	-	-	4	-	-	-	-	10	-	18	-	3	-	-	35
XII	-	-	-	-	-	-	-	-	-	-	3	-	2	-	-	5
XII/XIII	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2
XIII	-	1	-	-	-	-	-	-	-	-	1	-	3	-	-	5
XIV	-	1	-	1	-	-	-	-	1	-	3	-	10	-	-	16
XIV/XV	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
XVI	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
XVII	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
XIX	-	-	-	3	-	-	-	-	1	-	1	-	4	-	2	11
XX	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	2
XXI	-	-	-	1	-	1	-	-	-	-	-	1	1	-	-	4
Total	3	3	1	14	2	9	1	1	37	4	76	6	39	3	2	201

Anvil (ANV) — a block of stone, cobble or boulder on which a hard object is shaped or broken by hammering; a stone with a smooth face which bears an area (or areas), usually one or more cm in diameter, of concentrated pits, crushing and/or incisions.

Axe (AXE) — a tool used for chopping, cutting or splitting tough substances such as wood; a substantial slab or lenticular stone with a bifacially chipped or ground cutting edge transverse to its long axis and with elongated or notched sides suitable for hafting.

Biface knife (BIF) — an elongate and lenticular or occasionally a thin wedge-shaped stone with (a) bifacially chipped or ground edge(s) used for cutting or cleaving soft to moderately hard objects; the cutting edge is convex and durable; the tool is small to medium in size and is made of fine- to medium-grained material.

Chipping hammer (CHM) — a small hammerstone (less than 500 g) used for light precision pounding on small surfaces as, for example, in chipping stone; such hammers usually possess extensive areas of smooth unmodified cortical surface interrupted on an end(s) or side with a small crushed, pitted or incised contact zone generally less than 3 cm in diameter.

Chitho (CHI) — a medium to large discoidal scraping tool used on soft surfaces; medium-grained and sometimes friable stone; the edge, formed by crude chipping, extends around the perimeter of the tool and tends to be blunted by abrasion from use.

Chopper (CHP) — a rudimentary cleaver; a medium to large plano-convex or wedge-shaped spall with irregular bifacial chipping along a slightly convex edge; the cutting edge may be crushed due to use; tool made of well-consolidated fine- to medium-grained material.

Concave scraper (CSC) — a thin spall of fine- to medium-grained material with a concave edge(s) used for scraping moderately hard surfaces; the edge is formed by irregular chipping and crushing.

End scraper (ESC) — a small to medium-size flake tool which was either finger-held or socketed into a handle and used for scraping a moderately soft substance such as hide; a spall of fine-grained (usually microcrystalline) material with a steep unifacially chipped convex scraping edge transverse to its long axis.

Hammerstone (HAM) — a cobble of hard well-consolidated rock used for pounding hard or tough object(s); the cobble is usually elongate; the pounding surface, generally situated on an end, is usually flat but occasionally is pointed; the zone of contact is indicated by extensive crushing and/or pitting, and occasionally by flake scars originating at the edge of the contact surface and extending onto the adjoining side of the cobble; weight is greater than 500 g.

Marginally utilized or retouched lithic (MURL or MUR) — a residual category for chipped stone flakes which have been used as cutting, scraping or perforating tools either without special modification or with minor edge shaping by retouch; MURLs are small to medium-size tools (12-160 mm in length) and are generally made of microcrystalline to fine-grained materials (cf. Brink and Dawe 1989:187).

Pièce esquillée — see wedge.

Perforator (PRF) — a small pointed tool used to pierce or to bore a small hole in a soft to moderately hard material.

Projectile point (PPT) — the detachable tip of an arrow, dart, harpoon or spear; chipped stone projectile points are among the commonest of tools in the archaeological record of the northern Plains; fine elements of style, particularly of the haft area, are considered to be diagnostic of certain archaeological complexes.

Projectile point preform (PFM) — an unfinished projectile point; a blank which has the general shape and most of the finish of a projectile point, but lacks some aspect(s) of the finish such as notches.

Large scraper (SCR) — a large stone spall with a sharp, tough edge which has been used with little or no modification for scraping a soft to moderately hard material.

Wedge (WDG) — a small thin sharp-edged spall thought to have been used as a wedge for splitting materials such as antler, wood or bone; quadrilateral in plan with edges bifacially retouched and sometimes crushed; same as a pièce esquillée (MacDonald 1968); similar to a bipolar core (Hayden 1980; Shott 1989; LeBlanc 1992). Some specimens reported here as bipolar cores and MURLs might also be classified as wedges.

Most of the stone tools were recognized at the cataloguing stage, but a few were found during the detailed analysis of rock and chipping debris. After stone tools had been given tentative identifications and separated from other remains, analysis began with descriptive observations on form, measurements of dimensions and weight, identification of material type (same methods and reference materials as for chipped stone debris and rocks), provenience, and tentative assignment to a functional class. If preliminary functional identifications were not supported by continuing analysis, then a specimen might be reassigned to a more appropriate class. The thrust of deeper analysis was directed toward the discovery of additional evidence for manufacture and use. Some observations were made with the naked eye or with the aid of a 10 power lighted lens. These included: (1) the nature and extent of shaping processes — overwhelmingly by chipping, sometimes several kinds of chipping, with some crushing and grinding; (2) tool integrity — identification of missing elements and probable reasons for absence, such as never present or broken off; (3) evidence for repair — indicated by discontinuity of form within an element, discontinuity in the means used for shaping an element, unusual proportions of elements; and (4) gross evidence for use — certain kinds of breakage and dulling of edges. A limited attempt was made to refit flakes and shatter onto flake scars of tools, cores and other flakes. The purpose was to learn more about the manufacturing process, but the success level for refitting was very low. Considerably higher levels of success were achieved in refitting broken pieces of tools.

We made further observations on most stone tools with an 8-40 power Nikon binocular microscope for the purpose of identifying minute evidences of use-wear and/or adhering residues that might contribute to interpretations of tool function. Our use-wear observations were guided by studies such as those of Semenov (1964), Brink (1978), Hayden (1979b) and Vaughan (1985), but remained within the realm of relatively low-power magnification. Our observations on residues were informed by Briuer (1976), Anderson (1980), Loy (1983, 1987), Garfinkel and Franklin (1988), Newman and Julig (1989), Kooyman, et al. (1992), Smith and Wilson (1992), and by personal communications from Thomas Loy of the Department of Prehistory, Australian National University, Canberra, and by Patricia M. Alain, Chief Scientist-Serology, of the Central Forensic Laboratory, Royal Canadian Mounted Police, Ottawa. Efforts to verify our suspected residues on tools were limited to comparison

Table 4.6. Number of chipped stone flakes and shatter from the Sjovold site.

	Materials																
Layers	AGT	AND	CHR	CHL	FSH	GST	JAS	KRF	OBS	PPT	PWD	QTE	QTZ	SRC	SSD	Misc	UN	Total
I	-	1	3	-	-	-	-	2	-	1	5	-	-	4	3	-	3	22
I/II	-	-	1	-	-	1	-	-	-	3	-	-	-	-	1	-	-	6
II	4	1	5	1	-	12	-	1	-	1	-	-	16	-	-	-	3	44
II/III	-	1	1	-	-	-	-	-	-	1	2	-	1	-	1	-	-	7
III	5	3	95	1	1	71	-	-	-	442	64	229	6	492	24	7	4	1444
III/IV	-	-	5	-	-	18	-	-	-	121	-	160	-	17	-	-	3	324
IV-V	1	-	20	-	-	2	-	1	-	23	-	31	1	3	4	6	-	92
V/VI	-	-	3	-	-	-	-	1	-	8	2	1	1	2	1	-	-	19
VI	3	-	24	-	-	-	1	2	-	89	21	21	5	27	23	3	-	219
VI/VII	5	-	27	-	-	-	-	-	-	69	9	5	2	1	1	-	-	119
VII	4	-	8	-	-	7	-	3	-	83	10	23	5	18	15	-	-	176
VII/VIII	-	-	2	-	-	-	-	-	-	21	4	10	1	-	4	-	1	43
VIII	-	-	4	-	-	5	1	1	-	32	-	7	-	3	5	-	-	58
VIII/IX	1	-	5	-	-	5	2	5	-	117	17	8	8	21	12	1	-	202
VIII+IX	4	-	50	-	-	8	-	2	-	378	32	72	21	82	31	-	-	680
IX	8	-	11	-	-	-	-	2	-	548	45	18	51	87	15	1	-	786
X	13	-	65	6	-	4	2	23	1	328	16	88	50	60	29	1	2	688
XI	4	-	28	2	-	5	-	1	2	147	12	103	59	112	19	-	1	495
XII	-	-	2	-	-	-	-	19	-	2	3	3	2	5	1	-	-	37
XII/XIII	-	-	2	-	-	-	-	1	-	7	-		2	2	3	-	-	17
XIII	2	-	7	6	-	-	-	19	3	203	49	-	40	15	1	2	1	347
XIII/XIV	-	-	-	-	-	-	-	3	-	19	1	-	3	2	1	-	-	29
XIV	-	-	5	-	56	-	-	129	-	5	1	1	2	3	4	-	3	209
XIV/XV	-	-	1	-	-	-	2	8	-	-	-	3	5	1	29	1	-	50
XV	-	-	-	-	1	-	-	1	-	1	3	-	34	1	-	-	-	41
XVI	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
XVI/XVII	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2
XVII	3	-	5	-	-	-	-	9	-	2	-	-	1	9	4	-	1	34
XIX	-	56	19	-	1	-	-	16	-	152	61	6	38	9	4	-	2	364
XX	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	3
XX/XXI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
XXI	1	-	-	-	-	-	-	7	-	1	-	2	-	-	2	-	-	13
Total	59	63	398	16	59	139	8	259	6	2806	359	795	355	977	234	23	23	6570

Table 4.7. Weight of chipped stone flakes and shatter from the Sjovold site.

	Materials																
Layers	AGT	AND	CHR	CHL	FSH	GST	JAS	KRF	OBS	PPT	PWD	QTE	QTZ	SRC	SSD	Misc	UN	Total
I	-	1.3	6.7	-	-	-	-	1.2	-	34.3	2.9	-	-	1.9	2.9	-	1.6	52.8
I/II	-	-	0.5	-	-	0.8	-	-	-	8.4	-	-	-	-	0.4	-	-	10.1
II	1.1	0.1	1.4	0.2	-	10.6	-	0.2	-	6.9	-	-	30.5	-	-	-	2.8	53.8
II/III	-	0.3	0.6	-	-	-	-	-	-	1.8	0.5	-	0.9	-	0.1	-	-	4.2
III	13.3	0.5	113.3	2.2	-	101.4	-	-	-	535.3	77.6	694.9	40.2	239.0	38.7	12.8	1.3	1870.5
III/IV	-	-	3.4	-	-	2.9	-	-	-	64.0	-	69.0	-	3.1	-	-	0.3	142.7
IV-V	0.6	-	29.6	-	-	1.1	-	0.3	-	20.1	-	48.0	1.4	0.9	7.8	3.8	-	113.6
V/VI	-	-	4.6	-	-	-	-	0.2	-	5.5	2.5	0.1	0.2	0.3	0.1	-	-	13.5
VI	7.5	-	33.2	-	-	-	1.3	1.9	-	69.9	23.0	82.3	19.9	26.3	37.9	0.9	-	304.1
VI/VII	0.4	-	43.3	-	-	-	-	-	-	188.8	9.7	21.9	1.1	0.3	3.8	-	-	269.3
VII	6.1	-	37.4	-	-	22.0	-	1.5	-	302.5	16.5	127.6	9.0	19.0	11.5	-	-	553.1
VII/VIII	-	-	0.4	-	-	-	-	-	-	4.1	0.9	17.8	0.1	-	1.9	-	0.3	25.5
VIII	-	-	0.8	-	-	1.7	<0.1	0.2	-	70.3	-	20.9	-	17.6	3.0	-	-	114.5
VIII/IX	0.1	-	1.1	-	-	3.6	1.2	2.0	-	97.6	23.2	28.5	7.6	8.9	6.2	2.2	-	182.2
VIII+IX	2.2	-	152.9	-	-	43.3	-	1.1	-	635.1	41.6	428.5	286.9	93.8	65.1	-	-	1750.5
IX	4.1	-	32.2	-	-	-	-	1.6	-	788.5	61.4	87.9	68.9	147.3	16.6	1.7	-	1210.2
X	4.1	-	122.0	2.7	-	2.2	1.4	11.8	1.3	526.6	23.6	823.9	152.5	130.0	13.3	7.0	0.3	1822.7
XI	0.8	-	26.0	0.8	-	6.5	-	1.7	0.8	217.1	20.6	640.4	181.5	288.5	25.8	-	0.1	1410.6
XII	-	-	3.1	-	-	-	-	15.5	-	1.5	4.4	21.7	173.2	5.4	0.3	-	-	225.1
XII/XIII	-	-	1.9	-	-	-	-	0.2	-	9.1	-	2.7	10.8	0.9	-	-	-	25.6
XIII	1.0	-	17.2	13.2	-	-	-	20.3	0.4	568.7	62.3	-	91.9	10.2	<0.1	7.3	-	792.5
XIII/XIV	-	-	-	-	-	-	-	0.5	-	70.7	0.6	-	2.4	5.9	4.7	-	-	84.8
XIV	-	-	2.1	-	29.0	-	-	100.1	-	2.8	25.0	62.0	3.2	2.9	3.1	-	1.5	231.7
XIV/XV	-	-	3.0	-	-	-	0.6	3.2	-	-	-	104.7	4.1	0.1	72.9	106.5	-	295.1
XV	-	-	-	-	0.5	-	-	0.9	-	5.0	11.6	-	911.7	0.4	-	-	-	930.1
XVI	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	0.3
XVI/XVII	-	-	-	-	-	-	-	-	-	-	-	40.8	-	-	-	-	-	40.8
XVII	0.6	-	12.9	-	-	-	-	3.1	-	23.7	-	-	5.9	67.7	3.2	-	<0.1	117.1
XIX	-	182.5	12.2	-	0.2	-	-	12.1	-	301.1	167.3	254.9	96.3	103.6	44.0	-	0.5	1174.7
XX	-	0.9	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	1.0
XX/XXI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	-	6.2
XXI	0.1	-	-	-	-	-	-	2.0	-	7.7	-	29.1	-	-	2.9	-	-	41.8
Total	43.2	185.6	661.8	19.1	29.7	196.2	4.5	181.8	2.5	4580.3	626.8	3607.6	2100.5	1174.0	366.2	148.4	8.7	13870.7

of a small sample of our observations against similar observations on the same tools by Thomas Loy and Patricia Alain. The Loy and Alain observations tended to support our own. In almost all cases where we found residues that we thought were blood (mainly haemoglobin), they confirmed seeing the same residues and suspecting that they were blood residues. However, we were not in a position to pursue chemical verification, and the identifications must be regarded as tentative. More thorough studies of both use-wear and residues on Sjovold site tools would be warranted.

In an attempt to gain objective assessments of projectile point use, as darts or as arrowheads, we have applied Thomas' (1978) discriminant classification equations to 23 measurable specimens. The dart point (C_{dart}) and arrowhead (C_{arrow}) equations operate on measurements of length, width, thickness and neck width with the larger value indicating the proper classification (Thomas 1978:470). Although Thomas does not specify the amount of difference needed to support a decision, we have made a classification only when the equation results differ by a value of one or more. In cases where points are broken but almost complete (a small piece of the tip or base missing), estimated measurements have been included.

Chipped Stone Debris

Some 6,640 pieces of chipped stone debris from the block excavations are described in this report (see Tables 4.6-4.9). Debris refers both to flakes and shatter struck from a microcrystalline or fine-grained rock and to cores from which flakes and pieces of shatter have been struck. For this analysis, flakes are spalls with a striking platform, whereas shatter refers to spalls lacking striking platforms. Cores are classified according to a scheme used by Brink and Dawe (1989:238-242). Only complete or nearly complete cores have been included in this classification. Core fragments have been classified as shatter. Pebbles, cobbles and slabs of apparently chippable material which show no evidence for having been chipped are included under the category "rocks."

An analysis of individual flake attributes was carried out in the hope of being able to recognize stages of reduction and, for some flakes, the tool type whose manufacturing detritus they represented. However, most of that analysis was discarded after we found that it would not support our interpretative objectives. In the end we resorted to a sort of mass analysis (Ahler 1989) of flakes and shatter combined. We calculated the average weight for combined flakes and shatter for each material type in each occupation layer and classified these values according to size: small (less than 1.0 g), medium (1.0-2.9 g), or large (3.0 g or more). We interpret these size classes to represent fine, intermediate, and coarse phases of chipping, respectively. Given the small samples for any particular material in any particular layer, we were able to review the relevant portions of the collections in their entirety as we prepared their interpretation. This allowed us to detect and comment further on samples whose mean sizes are skewed by one or two large specimens or which represent a wider range of chipping activities than is suggested by their mean weight.

Table 4.8. Chipped stone cores from the Sjovold site.

	Materials													
Layers	CHR	CHL	GST	JAS	KRF	LIM	PPT	PWD	QTE	QTZ	SND	SRC	SSD	Total
Number														
I	-	-	-	-	-	-	-	1	-	-	-	-	-	1
II	1	-	-	-	-	-	-	-	-	-	-	-	-	1
III	3	-	1	1	-	-	1	1	1	-	1	-	-	9
IV-V	2	-	-	-	-	-	1	1	-	-	-	-	-	4
V/VI	-	-	-	-	-	-	1	-	-	-	-	-	-	1
VI	1	-	-	-	-	-	3	1	-	1	-	1	2	9
VI/VII	1	-	-	-	-	-	-	-	-	-	-	-	-	1
VII	-	-	-	-	-	-	-	-	2	1	-	1	-	4
VII/VIII	1	-	-	-	-	-	-	-	-	-	-	-	-	1
VIII	-	-	-	-	-	-	-	-	-	1	-	-	-	1
VIII/IX	-	-	-	-	-	-	-	-	-	-	-	1	-	1
VIII+IX	1	-	-	-	-	-	1	-	-	-	-	-	-	2
IX	2	-	-	-	-	-	-	-	-	3	-	-	-	5
X	-	-	-	-	1	1	2	-	-	-	-	1	2	7
XI	2	1	1	-	-	-	-	1	-	3	-	1	1	10
XII	1	-	-	-	1	-	-	-	-	-	1	1	-	4
XIII	-	-	-	-	-	-	-	-	-	-	-	1	-	1
XIII/XIV	-	-	-	-	-	-	1	-	1	-	-	-	-	2
XIV	-	-	-	-	-	-	-	-	-	-	-	1	-	1
XV	-	-	-	-	1	-	1	-	-	-	-	-	-	2
XIX	1	-	-	-	-	-	1	1	-	-	-	-	-	3
Total	16	1	2	1	3	1	12	6	4	9	2	8	5	70
Weight														
I	-	-	-	-	-	-	-	23.2	-	-	-	-	-	23.2
II	4.4	-	-	-	-	-	-	-	-	-	-	-	-	4.4
III	112.7	-	33.7	5.0	-	-	6.5	4.4	406.7	-	197.8	-	-	766.6
IV-V	32.9	-	-	-	-	-	32.1	102.9	-	-	-	-	-	166.9
V/VI	-	-	-	-	-	-	3.5	-	-	-	-	-	-	3.5
VI	2.9	-	-	-	-	-	21.6	31.2	-	5.4	-	2.7	4.7	68.5
VI/VII	8.2	-	-	-	-	-	-	-	-	-	-	-	-	8.2
VII	-	-	-	-	-	-	-	-	642.6	196.4	-	5.4	-	844.4
VII/VIII	4.3	-	-	-	-	-	-	-	-	-	-	-	-	4.3
VIII	-	-	-	-	-	-	-	-	-	56.6	-	-	-	56.6
VIII/IX	-	-	-	-	-	-	-	-	-	-	-	28.2	-	28.2
VIII+IX	28.5	-	-	-	-	-	22.0	-	-	-	-	-	-	50.5
IX	32.1	-	-	-	-	-	-	-	-	179.8	-	-	-	211.9
X	-	-	-	-	2.1	86.9	25.7	-	-	-	-	112.7	23.6	251.0
XI	5.7	21.0	6.8	-	-	-	-	4.1	-	523.1	-	4.6	2.4	567.7
XII	4.9	-	-	-	14.8	-	-	-	-	-	86.2	2.9	-	108.8
XIII	-	-	-	-	-	-	-	-	-	-	-	3.2	-	3.2
XIII/XIV	-	-	-	-	-	-	5.5	-	408.4	-	-	-	-	413.9
XIV	-	-	-	-	-	-	-	-	-	-	-	147.7	-	147.7
XV	-	-	-	-	53.6	-	27.1	-	-		-	-	-	80.7
XIX	7.6	-	-	-	-	-	13.1	7.8	-	-	-	-	-	28.5
Total	244.2	21.0	40.5	5.0	70.5	86.9	157.1	172.6	1457.7	961.3	283.8	307.4	30.7	3838.7

Table 4.9. Types of cores from the Sjovold site.

			Types			
Layers	Amorph	Bifac	Bipol	Simpl	Spall	Total
I	-	-	1	-	-	1
II	-	-	1	-	-	1
III	1	1	4	2	1	9
IV-V	-	-	4	-	-	4
V/VI	-	-	1	-	-	1
VI	-	-	9	-	-	9
VI/VII	-	-	1	-	-	1
VII	-	-	2	2	-	4
VII/VIII	-	-	1	-	-	1
VIII	-	-	1	-	-	1
VIII/IX	1	-	-	-	-	1
VIII+IX	-	-	1	-	1	2
IX	1	-	3	-	1	5
X	-	-	6	-	1	7
XI	-	-	9	-	1	10
XII	1	-	3	-	-	4
XIII	-	-	1	-	-	1
XIII/XIV	-	-	1	1	-	2
XIV	-	-	1	-	-	1
XV	-	-	2	-	-	2
XIX	-	-	3	-	-	3
Total	4	1	55	5	5	70

Our classification of material types relies on definitions in Rosenfeld (1965), Clayton, et al. (1970), Campling (1980), Johnson (1986), and Brink and Dawe (1989:188-196). Identifications were made by Ian Dyck on the basis of hand inspection or low power (8-40x) magnification, and with the aid of the Archaeological Survey of Canada lithic reference collection. The identifications rely on such secondary properties as grain-size, colour, lustre, hardness and fracture. Given the lack of chemical or crystal analysis these identifications should be regarded as provisional. Names and abbreviations used for rock types found among chipping debris and stone tools are: agate (AGT); amphibolite (AMP); andesite (AND); basalt (BAS); chalcedony (CHL); chert (CHR); fused shale (FSH); Gronlid Siltstone (GST); jasper (JAS); Knife River Flint (KRF); limestone (LIM); miscellaneous (MISC); obsidian (OBS); petrified peat (PPT); petrified wood (PWD); quartz porphyry (QPR); quartzite (QTE); quartz (QTZ); sandstone (SND); silicified sediment (SSD); Swan River Chert (SRC); and unidentified (UN).

Table 4.10. Bone tools from the Sjovold site.

Layers	Chopper	Pressure Flaker	Hide Grainer	Potting Tool?	Awl	Needle	Gaming Piece	Bead Byproduct	Groove & Splinter	Total
II	-	2	-	-	-	-	-	-	-	2
II/III	-	-	-	-	-	-	-	1	-	1
III	-	3	-	-	3	1	-	-	-	7
IV-V	2	1	1	-	-	-	-	-	-	4
VI	-	-	-	1	1	-	-	-	-	2
VIII	-	1	-	-	-	-	-	-	-	1
IX	-	-	-	-	1	-	-	-	-	1
X	-	-	1	-	-	-	-	-	-	1
XI	-	-	-	-	1	-	-	-	-	1
XIV	1	2	1	-	2	-	-	-	-	6
XIV/XV	-	1	1	-	-	-	-	-	-	2
XV	1	-	-	-	-	-	-	-	-	1
XVII	-	-	1	-	1	-	-	-	-	2
XIX	2	-	-	-	-	-	4	-	-	6
XX	-	-	-	-	-	-	-	-	1	1
XXI	1	-	-	-	-	-	-	-	-	1
Total	7	10	5	1	9	1	4	1	1	39

Bone Tools

Thirty-nine bone tools have been recognized in the Sjovold assemblages (Table 4.10). They can be divided into two major categories: (1) tools shaped by fracturing and use; and (2) tools shaped by cutting, scraping and grinding. The first category includes choppers, pressure flakers, hide grainers, and a possible potting tool. The second includes awls, needles, gaming pieces, a bead byproduct, and a grooved-and-splintered bone. These tools are described in detail in the following chapters, but several of the types deserve brief collective description.

Bone choppers are long bone fragments on which one end has a heavily battered, chipped and polished fracture surface. Frison (1970:26 ff., 1974:29 ff., 1978:306 ff.; Reher and Frison 1980:24-25) has described the forms and functions of bone choppers at great length. Some of his inferences have been challenged by Binford (1981:70-71) who believes that the humerus choppers in particular are the results of carnivore gnawing rather than tool use. We suspect that Binford is correct in the case of proximal humeri with scalloped edges (see Frison 1970: Fig. 19a-d; 1974: Fig. 1.14b; 1978: Fig. 8.7), but the Sjovold humerus chopper bits (Layers IV-V, XIX) do not fall into this category. Instead, they are heavily utilized fracture edges formed on the thickest part of the humerus shaft, and they show no traces of carnivore gnawing. Binford (1981:76) notes that it is less likely that Frison's tibia choppers were produced by animal gnawing, and several of the Sjovold choppers are very similar to tibia and metatarsal choppers from Casper (Frison 1974: Fig. 1.14a, 1.18) and Vore (Reher and Frison

1980: Fig. 25). Frison (1978:306) suggests that bone choppers were used "only to chop into the relatively soft muscle attachments." Lemoine (1989:213) used experimental choppers to chop through joints, and her work produced battered and polished areas that appear identical to the wear seen on the Sjovold chopper bits.

Pressure flakers are rib fragments with one or both ends worn to rounded, sometimes beveled, facets formed by crushing a fracture surface. There are a few isolated striae on a few of the facets, and some facets are bordered by polished high spots. However, the facets are neither generally striated nor generally polished. They are dull in appearance, having less lustre than the cortical surfaces of the rib fragments. They are not smoothed, as if abraded, and they appear to have formed from adhesive wear and surface-fatigue wear (see Rabinowicz 1962; Lemoine 1994). In fact, some of these tools appear to have been exhausted when the facet surface collapsed, and three specimens are small tool fragments produced by such collapse. Other examples appear to have been discarded when the handle broke and rendered them too short for further use. Assuming that we have correctly identified these tools as pressure flakers, they exhibit some noteworthy design features. All of the them are made on flat rib segments where the cancellous tissue in the medullary cavity is relatively thin. This feature maximizes the amount of cortical bone exposed by a transverse or oblique fracture through the rib, and it is the cortical bone that has become faceted during use. There is no evidence that the fracture surface was reshaped deliberately, and the rounded facet outlines, seen when viewing the lateral surface of the rib, appear to have been formed by use. The sectional view is seen by viewing either the anterior or posterior edge, and it may be flat, rounded, beveled in (toward medial) or beveled out (toward lateral); in this view, also, the form of the facet appears to have been achieved through use rather than design. An unhafted pressure flaker has a limited range of optimum length. If it is too long, it is unwieldy. If it is too short, it will not span the hand to provide a secure grip by all four fingers, and leverage will be reduced. Discounting small fragments, it is interesting that the flakers with facets surviving relatively intact are the shortest flakers, and these exhibit fresh-state fractures in the handle area. Longer flakers may have been discarded because of facet collapse.

Hide grainers are bison metapodials that exhibit various degrees of distinctive damage near their distal ends (see Fig. 4.1). We have not seen such specimens described previously, but we speculate that the damage represents stages in the use of these bones in a hide-working function such as the removal of the grain layer. "In the traditional way of making Indian smoke tanned leather the entire grain layer of the skin was removed by scraping with a sharp tool. If the grain layer was not entirely removed, the skin could not be properly softened prior to smoking" (Coxworth 1972:5). Most ethnographic and historical reports describe the use of coarse stone tools as hide grainers, but a few mention bone tools for this purpose. For example, Denig (1930:541) describes the Assiniboine method of hide graining:

> A fire is then made near and the skin slowly heated and rubbed with pumice stone or porous bone until it is about half dry, then taken out of the frame and drawn backward and forward round a strong cord of sinew which is tied at each end to the lodge pole.

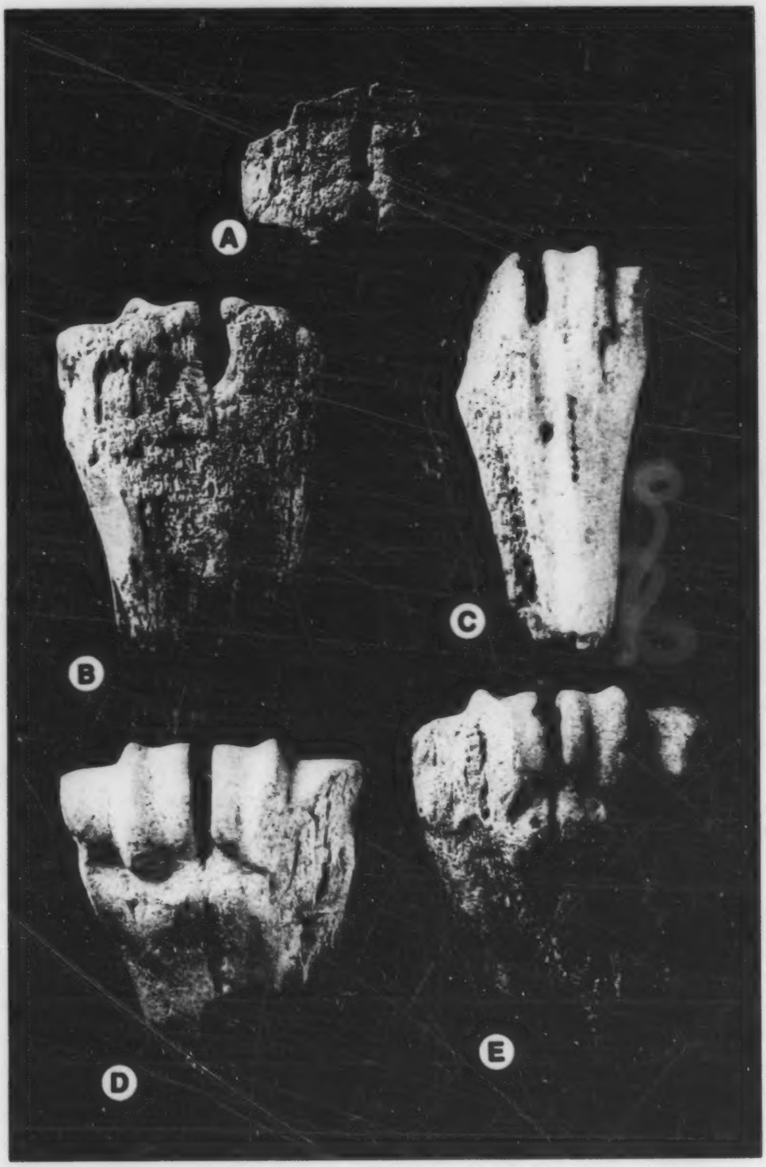


Figure 4.1. Bone hide grainers from the Sjovold site. A. Layer X metatarsal (EiNs-4:3271); B. Layer XVII metacarpal (7013); C. Layer XIV metatarsal (6470); D. Interlayer XIV/XV metacarpal (6686); E. Layer IV-V metacarpal (2294).

> Every few minutes the skin is held a short time to the fire, then rubbed, and this operation continued until it becomes perfectly dry and soft.

Similarly Mooney (1910a:592) presents a general picture for native North America:

> ...the skin is left suspended in the frame to dry and bleach until it is ready for graining. This is done with a globular piece of bone, as large as can be conveniently held in the hand, cut from the spongy portion of the humerus of a buffalo or other large animal. With this the whole surface of the skin is rubbed as with sandpaper to reduce the hide to uniform thickness and smoothness and to remove any hanging fibers.

Although neither of these reports mentions distal metapodials, inspection of the Sjovold specimens reveals porous or spongy bone well exposed in globular pieces of convenient size to be hand-held. The spongy surfaces range from very slightly concave to broadly biconvex, and they are locally polished on high spots and on compact tissue surrounding the affected area. The variation in surface topography suggests wear against a firm but yielding surface such as a hide placed on the ground or held in a frame. The local polish suggests an abrading function, and mosaic cracking on several specimens might have been caused by repeated wetting and drying of the bone. We imagine that the distal metapodial might be selected for hide graining because of the well defined sagittal ridges and condylar borders that would perform as abraders from the onset of use. As compact tissue became degraded and lost, an enlarging area of cancellous tissue would assume the same function, effectively improving tool performance. Eventually, however, wear would continue through the midline of the tool and expose a diminishing working surface leading to tool exhaustion.

Awls are bone fragments that have been shaped by scraping and/or grinding to form a pointed end. Some specimens taper gradually to a point, and others have abruptly constricted tips that may have been designed to gauge depth of penetration. Some are very slender, delicate slivers with very sharp tips, and others are heavier tools with relatively blunt tips; however, all the tips appear sharp enough to penetrate a hide, and some of them have been locally damaged by such a function. Longitudinal striations can be seen at low magnification on most of the awls, and these probably result from primary shaping of the tapering point. Three specimens (Layers III, XVII) exhibit delicate transverse striations near the tip, and these match experimentally induced striations attributed to contact with hair on a fresh hide (Lemoine 1989:213, Fig. 7).

The other types of bone tools are described in Chapters 6-25.

Chapter 5

Faunal Remains

Introduction

We assume that the Sjovold site witnessed many natural biotic events, as well as cultural events, that have contributed to the faunal assemblage. In this chapter we preview the faunal remains by justifying our taxonomic identifications, surveying the rapidly growing literature on bone modifications, and considering site-wide patterns of fragmentation, survivorship, age and gender among the bison bones. The Sjovold excavations yielded 25,312 specimens of bone, tooth, and horn, as well as 49 fragments of freshwater clamshell, 53 small snail shells, and three samples of avian eggshell (Table 5.1). It is noteworthy that the abundance of bone is usually one or two orders of magnitude greater in the occupation layers than in the interlayers between them. To some extent this reflects the role of bone abundance in recognizing and defining the occupation layers, but it also shows that faunal frequencies co-vary with feature and artifact frequencies, suggesting that most of the faunal remains are related to human occupation of the site.

The invertebrates and eggshells have not been identified to species, but the vertebrate taxa are listed in Table 5.2. Lists of occurrences indicate layer analyses where the faunal remains are described in greater detail and interpreted with respect to taphonomic histories. Small asterisks in the occurrences column mark samples believed to be partly or wholly intrusive after the formation of the layer or interlayer deposit (Table 5.2).

Except for the fishes, all vertebrate specimens have been identified by R.E. Morlan through direct comparison with documented reference skeletons. The fish remains were identified by Darlene Balkwill, Canadian Museum of Nature. Both cranial and postcranial materials have been studied, despite the difficulty of obtaining adequate reference materials in some cases. Especially for small mammals, it is rare to find skeletons in which podial elements have been prepared, because the radioulna and tibiofibula are usually broken with more distal elements being retained in the skins that are curated for museum collections. The Osteological Collections of the Canadian Museum of Nature have been invaluable to this study, because many of the skeletons are complete.

Invertebrates

Since the freshwater clamshells have not been (cannot be?) identified, we are unable to consider their paleoenvironmental implications (e.g. Warren 1991), although we can speculate on the reasons for their occurrences in the Sjovold site. It is noteworthy that these clamshells do not appear below

Table 5.1. Vertebrate classes, invertebrate orders, and bone weight (g) in the Sjovold site.[a]

Layer	Clam	Snail	Fish	Amphibian	Bird	Mammal	Weight
I	-	-	-	-	-	308	496.4
I/II	-	-	-	-	-	65	58.7
II	-	5	-	-	E	240	1,251.3
II/III	-	-	-	-	-	72	46.1
III	1	-	-	-	-	1,570	2,505.4
III/IV	-	-	-	-	-	111	50.2
IV-V	-	2	-	-	-	640	770.4
V/VI	-	2	-	-	-	67	16.1
VI	1	1	1	1	1	1,270	3,287.4
VI/VII	5	-	-	-	-	305	275.4
VII	13	-	-	-	-	1,360	3,885.0
VII/VIII	-	1	1	-	-	265	221.3
VIII	1	-	3	-	-	34	499.9
VIII/IX	1	1	-	-	-	194	191.3
VIII+IX	17	-	-	-	-	901	1,994.0
IX	10	1	-	-	-	307	1,275.6
X	-	16	-	-	-	4,187	11,093.7
XI	-	6	-	-	1	2,888	9,724.6
XII	-	-	-	-	-	414	3,039.7
XII/XIII	-	-	-	-	-	194	1,763.2
XIII	-	1	-	24	E,1	807	2,258.6
XIII/XIV	-	-	-	-	-	100	63.2
XIV	-	-	-	-	-	2,594	7,631.6
XIV/XV	-	-	-	-	-	631	1,278.0
XV	-	1	-	-	E,1	473	663.0
XVI	-	-	-	-	1	149	1,406.3
XVI/XVII	-	-	-	-	-	256	664.2
XVII	-	1	-	-	-	665	754.0
XVIII	-	-	-	-	-	3	32.0
XIX	-	3	-	-	6	2,932	7,766.3
XX	-	-	-	-	-	149	239.2
XX/XXI	-	12	54	-	-	272	344.4
XXI	-	-	-	-	-	794	3,440.1
Total	49	53	59	25	11	25,217	68,986.6

a. E in Bird column represents the occurrence of eggshell.

Layer IX (Table 5.1); they are restricted to the part of the sequence that was buried by colluvial and aeolian processes and therefore they cannot have entered the site as fluvial sedimentary particles. Whole clams or shell fragments could have been introduced to the site surface by people or by non-human predators and scavengers. We have found no tool marks on the shell fragments, but some shells might have been collected as raw materials for tools or ornaments that were carried elsewhere. There is no evidence that clamshell was collected as a ceramic tempering material (e.g. Theler 1990). The association of clamshells with a hearth feature in Layer VII suggests dietary use, but, as Aaberg (1991:65) notes in a discussion of a recently discovered shell midden in Montana, "almost nothing is known of the systematic exploitation of freshwater mussels by plains aboriginals."

In contrast to the clamshells, small snailshells are scattered throughout the stratigraphic sequence, and their low frequencies reflect the inadequacy of quarter-inch screens to recover such small items. Although not identified, all of the snails are small terrestrial varieties that are abundant in both alluvial and aeolian sediments (e.g., Bobrowsky 1984).

Fishes, Toads and Birds

Except for the Common Raven, all of the fishes, amphibians and birds recovered from the Sjovold site are well known in the area today. Ravens do not nest in the Sjovold area at the present time, but they may occur there during the winter (Godfrey 1966:275). However, ravens formerly bred locally in the Great Plains region as far south as Oklahoma and northern Arkansas (Nice 1931; AOU 1957:378; Bent 1964:202) where they played an important role as scavengers on campsite and kill site debris.

Avian eggshell fragments were recovered from three components (Layers II, XIII, XV), and we use measurements of their thickness to suggest the approximate size of the species represented. Pigmented marks are not preserved, and all fragments are dull off-white in colour. Several variables influence egg size and eggshell thickness in birds. In general, egg size is positively correlated with bird size, but precocial (feathered, ambulatory) species lay proportionately larger eggs than altricial (naked, nest-bound) species (Terres 1980). Diet may influence eggshell thickness, and pesticide burdens cause eggshell thinning (Vermeer and Reynolds 1970; Enderson, et al. 1982; Court, et al. 1990). With so many variables involved, it is unlikely that eggshell thickness can be used alone to identify birds, even to order. However, the measurements shown in Table 5.3 suggest that the Sjovoid eggshells do not represent small songbirds. The thickest eggshells, from Layer XV, are from a very large species, such as a swan or pelican. Those from Layer XIII might represent a duck, and the eggshells from Layer II may be of grouse size.

Possibly the eggshells were introduced to the site by people who gathered eggs to eat. Macoun (1882:367-368) notes, in a discussion of loons and grebes on Water Hen River and Lake, in Manitoba, that "the Indians collect large numbers of eggs in the proper season, and one old fellow ... astonished me by the remark that he could have fresh eggs all summer. On enquiry, I learned that he went regularly to the same nests, and never took all the eggs, so that he kept the poor bird laying all summer."

Table 5.2. Frequencies, names and occurrences of vertebrate taxa.*

NISP	English Name	Scientific Name	Occurrences
55	Fish, unidentified	Osteichthyes	VI, VIII, XX/XXI
1	Minnow	Cyprinidae	VII/VIII
1	Sucker	cf. *Catostomus* sp.	XX/XXI
1	Sunfish	Centrarchidae	VIII
1	Yellow Perch	*Perca flavescens*	XX/XXI
25	Canadian? Toad	*Bufo* cf. *hemiophrys*	VI, XIII*
4	Bird, unidentified	Aves	XIV, XV, XIX
1	Shoveler?	*Anas* cf. *clypeata*	XIII
1	Eagle	*Aquila* or *Haliaeetus*	XVI
1	California? Gull	*Larus* cf. *californicus*	VI
1	Horned Lark	*Eremophila alpestris*	XIX
3	Common Raven	*Corvus corax*	XI, XIX
1	Veery	*Catharus fuscescens*	XIX
23,964	Mammal, unidentified	Mammalia	All layers & interlayers
51	Rabbit or Hare	Leporidae	I, III, III/IV; IV-V*, V/VI*, VI*, VI/VII, VII*, VII/VIII, VIII-X*, XI*, XIV, XVII, XIX
22	Nuttall's? Cottontail	*Sylvilagus* cf. *nuttallii*	III, IV-V*, VI*
25	Snowshoe Hare	*Lepus americanus*	II, IV-V*, VI*, XIX
3	White-tailed Jackrabbit	*Lepus townsendii*	III, VI, VII/VIII
2	Least Chipmunk	*Tamias minimus*	X, XII/XIII
40	Ground Squirrel	*Spermophilus* sp.	II*, II/III*, III*, III/IV*, IV-V*, V/VI*, VI*, VII*, VIII-X*, XII/XIII*, XIV/XV*
2	Northern Pocket Gopher	*Thomomys talpoides*	X
1	Beaver	*Castor canadensis*	IX
2	Deer? Mouse	*Peromyscus* cf. *maniculatus*	XIX
2	Gapper's? Red-backed Vole	*Clethrionomys* cf. *gapperi*	III*, X
3	Muskrat	*Ondatra zibethicus*	VI
6	Meadow Vole	*Microtus pennsylvanicus*	VII, XXI
1	Jumping Mouse	*Zapus* sp.	XII/XIII*
1	Porcupine	*Erethizon dorsatum*	III
2	Carnivore, unidentified	Carnivora	IV-V, X
7	Wolf, Dog or Coyote	*Canis* sp.	VIII/IX, VIII-X, XIII, XV, XIX
24	Wolf	*C. lupus*	X
2	Wolf or Dog	*C. lupus* or *C. familiaris*	XIV/XV
48	Dog	*C. familiaris*	I, III, VI, VI/VII
25	Dog or Coyote	*C. familiaris* or *C. latrans*	VII, XX
1	Swift Fox	*Vulpes velox*	XVII
1	Grizzly Bear	*Ursus arctos*	VIII-X
2	Marten or Fisher	*Martes* sp.	III, XIX

Table 5.2 (Continued).

NISP	English Name	Scientific Name	Occurrences
1	Fisher	*Martes pennanti*	VI
2	Badger	*Taxidea taxus*	III
1	Striped Skunk?	cf. *Mephitis mephitis*	VI/VII
1	Otter?	cf. *Lutra canadensis*	III
2	Lynx?	*Lynx* cf. *lynx*	II/III, XIV
1	Artiodactyl, unidentified	Artiodactyla	XIV
13	Deer or Pronghorn	*Odocoileus* or *Antilocapra*	III, IV-V, VII, VIII/IX, X, XIII, XIV, XXI
8	Deer	*Odocoileus* sp.	II, III, VII, XII
1	Moose	*Alces alces*	III
3	Wapiti	*Cervus canadensis*	XIV
7	Pronghorn	*Antilocapra americana*	VIII, X, XX
940	Bison	*Bison bison*	All layers
25,312			

a. Superscripts (*) signify that some or all elements are believed to be intrusive into the layer or interlayer.

Table 5.3. Thickness of modern and archaeological birds' eggshells.

Taxon	Thickness[a]	Reference
Australian Swan	0.69	Romanoff and Romanoff 1949:150
White Pelican	0.686	Anderson, et al. 1969:103 (pre-1940)
Holland Turkey	0.41	Romanoff and Romanoff 1949:150
Cormorant	0.434	Anderson, et al. 1969:103 (pre-1940)
Great Blue Heron	0.32-0.43	Vermeer and Reynolds 1970 (<20 ppm DDE)
Herring Gull	ca. 0.38	Hickey and Anderson 1968 (<20 ppm DDE)
Mallard	0.37-0.38	Heath, et al. 1969
Peregrine Falcon	ca. 0.36	Court, et al. 1990
Leghorn Chicken	0.31	Romanoff and Romanoff 1949:150
Ring-necked Pheasant	0.26	Romanoff and Romanoff 1949:150
Quail	0.13	Romanoff and Romanoff 1949:150
American Robin	0.13	Morlan, personal observation, 1991
Mourning Dove	0.10	Morlan, personal observation, 1993
Red-winged Blackbird	0.10	Morlan, personal observation, 1991
Hummingbird	0.06	Romanoff and Romanoff 1949:150
Sjovold site	**Thickness**	**Catalogue Number**
Layer II	0.20-0.23	EiNs-4: 472
Layer XIII	0.34-0.37	EiNs-4: 5848 (screen recovery)
Layer XIII	0.31-0.37	EiNs-4: 5725 (planview recovery)
Layer XV	0.60-0.66	EiNs-4: 6872

a. Measurements in mm. Except for personal observations, thickness measurements have been selected to avoid the influence of eggshell thinning that results from pesticide burdens.

Mammals

The mammal remains pose the most complex analytical problems not only because they comprise the most abundant class but also because one can expect to find a variety of taphonomic histories among them. On the one hand, we presume that the larger a mammal the more likely its presence results from human activity. On the other hand, we are eager to determine whether smaller mammals played a role in the subsistence and other pursuits of northern Plains bison hunters. We have adopted a series of body size classes that help to clarify the relationships between mammal size and taphonomic history (Table 5.4). Many unidentified bone fragments can be assigned to size classes that suggest relationships to the identifed specimens with which they are associated. In Chapters 6-25, the faunal remains are listed by size class from largest to smallest. The frequencies of size classes are strongly biased by recovery methods that depended on quarter-inch (6.35 mm) screens (Fig. 5.1, Table 5.5; see Thomas 1969).

Table 5.4. Mammal body size classes based on live weight.[a]

Size	Weight	Examples
1	< 100 g	mice, voles, Least Chipmunk
2	100-700 g	ground squirrels, Northern Pocket Gopher
3	700-5000 g	rabbits, hares, Muskrat, foxes, Marten, Fisher, some Badgers, Striped Skunk
4	5-25 kg	Beaver, Porcupine, some Dogs, Coyote, some Badgers, Wolverine, River Otter
5	25-200 kg	Wolf, some Dogs, deer, Pronghorn
6	200-700 kg	Moose, Wapiti, Bison
7	>700 kg	a peculiar bone in Layer VI (see Chapter 10)

a. Weight classes modified after Thomas (1969)

Complete skeletons of Snowshoe Hare (NMC-31929) and White-tailed Jackrabbit (NMC-34376) are available for study, but for Nuttall's Cottontail only the skull and mandible (NMC-8343) have been obtained. We measured a complete skeleton of Eastern Cottontail (NMC-75202) for comparison with the hare and jackrabbit. Differences in size are used to identify some of the anatomical elements of these species. The smallest is Nuttall's cottontail, followed by Eastern Cottontail, Snowshoe Hare, and White-tailed Jackrabbit, but there is substantial overlap among the smallest three taxa. Only bones known by fusion of sutures and epiphyses to represent adults can be sorted on the basis of size alone. A few postcranial elements exhibit subtle but reliable morphological features that permit separation of rabbits from hares (Rick 1978). Rick's study was restricted to Eastern Cottontail and Snowshoe Hare, but we have confirmed that the criteria are valid for the White-tailed Jackrabbit and assumed they are valid for Nuttall's Cottontail.

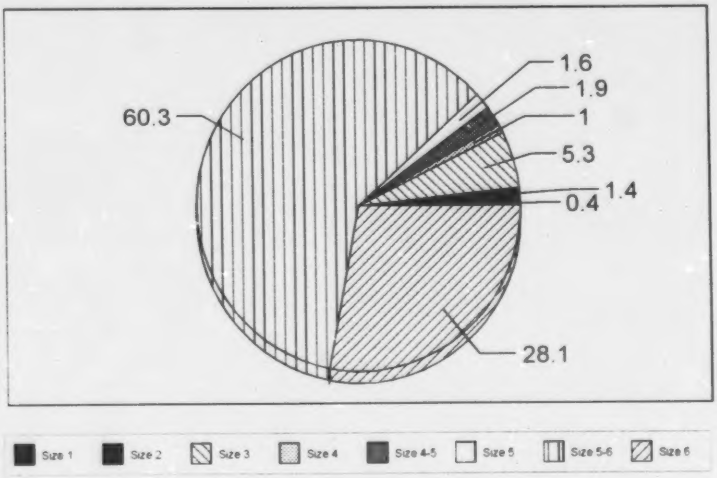


Figure 5.1. Percentage NISP (number of identified specimens) by mammal body size.

Table 5.5. Modified vertebrate remains from the Sjovold site.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
7, mammal	-	-	-	-	1	-	-	-	1	-	-	1
6, mammal	36	11	70	4	223	810	97	28	208	446	166	945
5-6, mammal	42	122	41	3	*	*	512	66	305	1,146	-	2,029
5, mammal	1	1	7	1	12	45	7	2	12	23	11	55
4-5, mammal	1	-	1	1	2	10	1	1	5	9	2	18
4, mammal	5	4	1	3	3	63	13	15	10	13	31	82
3, mammal	-	3	7	30	-	67	4	1	12	92	67	176
2, mammal	-	-	-	5	-	4	-	2	3	15	27	47
1, mammal	-	-	-	2	-	5	3	-	1	5	4	13
-, mammal	24	4422	25	567	*	*	*	*	*	*	*	21,850
Bird	-	-	1	-	-	8	-	-	-	6	6	12
Amphibian	-	-	-	-	-	1	-	-	-	1	24	25
Fish	-	-	-	-	-	2	-	-	54	1	4	59
Total	109	4,563	153	616	241	1,015	637	115	611	1,757	342	25,312

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

The Sjovold site is well within the modern range of the Snowshoe Hare and White-tailed Jackrabbit, but it is very near the northeastern limit of Nuttall's Cottontail and well outside the northwestern limit of Eastern Cottontail (Banfield 1974; Hall 1981). A record of Nuttall's Cottontail at Dundurn, Saskatchewan, is the only previously reported occurrence farther to the northeast (Banfield 1941; Beck 1958). Except for two tentatively identified metatarsals in Layer III, all of the cottontail remains are believed to be intrusive into the Sjovold site by way of a loosely infilled, probably very recent, badger burrow. Nonetheless, these bones represent the only confirmation of the Dundurn record to demonstrate the historic presence of this species so far northeast.

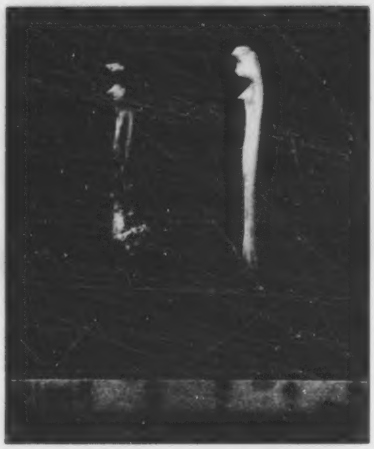


Figure 5.2. Pathology on a ground squirrel ulna from Interlayer XII/XIII (EiNs-4:5550) compared with a normal ulna.

The sciurid rodents of central Saskatchewan differ considerably in size, ranging from the Least Chipmunk, through the Northern Flying Squirrel, Red Squirrel, Thirteen-lined, Richardson's and Franklin's Ground Squirrels, to the Woodchuck; there is considerable size overlap between the two largest ground squirrels. Complete or partial skeletons of all these taxa are available for study, and a complete skeleton of Richardson's Ground Squirrel (NMC-75302) has been particularly useful. Each of the three ground squirrels belongs to a different subgenus and can be recognized on dental characters summarized by Hall (1981).

Among the sciurid rodents, only the chipmunk and ground squirrels are known to inhabit the site area today (Beck 1958; Banfield 1974; Hall 1981). The occurrences of Least Chipmunk are interesting because of conflicting versions of its modern distribution. Banfield (1974: Map 44) maps a boundary approximately along the parkland/plains border with an isolated population in the Cypress Hills. His map is consonant with the distribution of Saskatchewan records shown by Beck (1958:29) who reports specimens just north and east of the Sjovold site but none to the southwest until one reaches the Cypress Hills. Hall's (1981: Map 236) map apparently is designed to account for the fact that the subspecies found in the Cypress Hills is the same as that of boreal Saskatchewan and Alberta, and he includes almost all of the grassland areas within the species distribution. Hall's map is poorly supported by specimens from the grasslands, and we can only suppose that it could reflect the ability of Least Chipmunks to live in "coulees on the arid sagebrush plains wherever there is adequate cover" (Banfield 1974:100). At the present time it is not possible to determine whether the Sjovold site is marginal or central to the Saskatchewan distribution of Least Chipmunks.

In view of their burrowing habits, ground squirrel bones are often assumed to be intrusive into archaeological sites. All of the ground squirrel remains from the Sjovold site are interpreted as intrusive but not because of their own burrowing habits. Ground squirrels burrow to live, not to die, and we have no reason to believe that we have encountered an unsuccessful hibernaculum. Rather than being self-intruded, their digested remains have been introduced to the site by burrowing and burrow-using predators (see Morlan 1994a). A ground squirrel ulna from Interlayer XII/XIII exhibits a gross pathology on its distal end. A large callus, up to 8 mm in diameter, has formed at the probable site of a fracture that failed to heal properly due to dislocation or infection (Fig. 5.2). The radius must also have been involved but was not recovered.

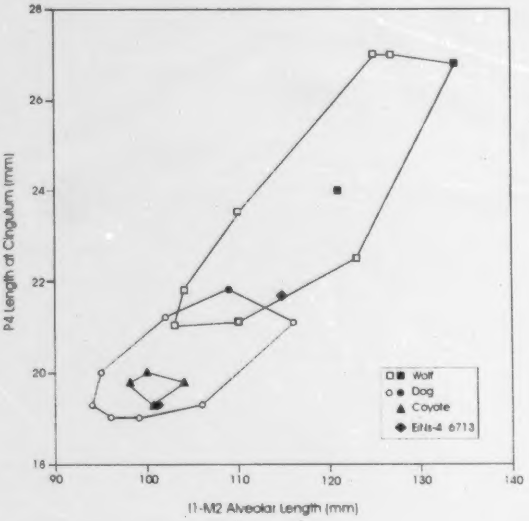


Figure 5.3. Maxillary dimensions of northern Plains canids.

Large canids are second only to bison in the Sjovold faunal assemblage, but they are very hard to identify to species since the bones are fragmentary and mainly post-cranial. Species identifications are usually based on relatively complete skulls and mandibles that can provide numerous measurements suitable for multivariate analysis (Morey 1986, 1992; Morey and Wiant 1992; Walker and Frison 1982). The Sjovold excavations yielded only a partial maxilla and one complete mandible. The other 104 specimens consist of isolated teeth and post-cranial elements. Rather than leaving all of these specimens under a generic rubric (*Canis* sp.), we have developed a method of providing tentative species assignments for some of them. We measured all suitably preserved girdle and limb bones, as well as atlas and axis, from the Sjovold site and collected corresponding measurements from large and small specimens of wolf, dog, and coyote to gain an impression of their relative sizes. These reference specimens can be related to the size ranges of northern Plains canids by plotting maxillary tooth row length against upper carnassial length using data published by Morey (1986). From Figure 5.3, it is clear that our larger dog is at the upper size limit of northern Plains dogs and is slightly larger than the smallest northern Plains wolves. Coyotes fall within the lower part of the range for northern Plains dogs on this particular pair of measurements, and our smaller dog is near the lower limit for dogs. Our smaller wolf (a female from Alberta) can be considered typical of northern Plains wolves.

The relative sizes shown in Figure 5.3 would not be an adequate basis for analysis were it not for other variables. For example, we observed significant allometric differences between dogs, on the one hand, and wolves and coyotes on the other. Allometric patterning has previously been observed in canid crania (Morey 1992), and we found a distinctive pattern throughout the post-cranial skeleton.

Most long bones in our dog skeletons are longer than those of the coyotes and shorter than those of the wolves, but the dog bones are much broader and deeper in relation to their length than either coyotes or wolves. This pattern continues down the limb through the metapodials that in dogs remain broader and deeper even when they are shorter than those of coyotes. We find a regression line running through all wild canid measurements, including foxes, when either width or depth (y-axis) is plotted against length (x-axis), but the dogs depart from that line and form a steeper one. This finding deserves further study that is beyond the scope of this report, but for now the tentative identifications of large canids are based both on size and on allometric relationships that reflect post-cranial paedomorphosis (retention of juvenile traits; see Morey 1994). The identifications are justified more fully in the layer-by-layer analyses as required by the recovered materials.

The Swift Fox skull is identified on the basis of its small size (measurements in mm: P^4 length, 10.5; P^4 breadth, 4.8; M^1 length, 7.7; M^1 breadth, 8.8; M^{1-2} alveolar length, 10.5). The Grizzly Bear mandible is identified on the basis of its enormous size, although no measurable anatomical features are preserved.

Complete skeletons of all mustelids known in the Sjovold site area are available for study. In most cases, each species is represented by a series of different ages and sexes that permit careful evaluation of the significance of size differences. This is an important consideration for mustelid analysis because of marked sexual dimorphism in many taxa. The Sjovold Fisher mandible fragment matches the size of an adult male (M_1 measurements [mm]: length, 12.3; trigonid length, 8.3; trigonid breadth, 4.8), rendering it unlikely that the identification is incorrect since all other mustelids that could be confused with it are smaller (see Anderson 1970: Fig. 31).

The presence of Fisher, *Martes pennanti*, is somewhat unexpected, because the southern limits of both its modern and historic range are north and east of the Sjovold site (Beck 1958:18; Banfield 1974:319; Powell 1981; Graham and Graham 1990). Banfield (1974:319) notes that the Fisher is "a denizen of the climax coniferous forest... Unlike the marten, it will venture into subclimax deciduous groves and old burns." Perhaps the aspen parkland offered suitable habitat before cultivation became widespread.

Analysis of the large mammals made reference to many skeletons in the Canadian Museum of Nature and Canadian Museum of Civilization. One bison skeleton (NMC-75120), an adult male from Elk Island National Park, Alberta, was particularly important during this study. Since bison is by far the most abundant identified taxon in the Sjovold site, the bison assemblage is discussed in some detail below.

It is well known that many large mammals, including the Grizzly Bear, Moose, Wapiti, Pronghorn, and Bison, were formerly widespread and locally or seasonally abundant in the northern Plains. For example, travelling overland southwestward from the Carrot River in late July and early August, 1754, Anthony Hendry encountered both moose and wapiti almost daily and first sighted bison on 15 August about 40 miles (64 km) east of the South Saskatchewan River and somewhat north of the location of Saskatoon (Burpee 1907:315, 326-329; Ruggles 1987). Nearer the Sjovold site, the brushy coulee, the river banks, and the wooded sand dunes east of the river would have provided habitat for deer and wapiti, while the surrounding grasslands supported pronghorn and bison herds.

Bone Modifications

Each bone, tooth, or fragment has been examined for fractures, cut marks, burning, tooth marks, evidence of digestion, weathering, rootlet etching, staining, and pathology (Tables 5.5-5.6). These modifications represent landmarks in the taphonomic histories of specimens and assemblages. A given specimen can be cumulatively modified with individual changes superimposed to reflect a sequence of events, or one modification may eventually obscure another to render the history unintelligible. The latter outcome appears to be rare in the Sjovold site except for occasional pervasive rootlet etching that may have obscured earlier modifications such as tooth marks or cut marks. Our observations are conditioned by the extensive and growing literature on bone modification (e.g. Bonnichsen and Sorg 1989) as well as Morlan's experience with previous faunal analyses and studies of digested bones from modern pellets and scats (Morlan and Matthews 1992).

Fractures are recorded as fresh, dry, or recent. Fracture surfaces in fresh bone are relatively smooth and may form acute, obtuse or right angles with the outer surface of the bone (Morlan 1984: Table 1). Such fractures usually terminate at or prior to the epiphyses in long bones, although proximal metapodials in artiodactyls contain so little cancellous tissue that fractures may continue through them. Fresh-state fractures may have almost any outline form but are generally smoothly curving without abrupt offsets along a given margin. Abrupt offsets are typical of dry-state fractures, and they represent perturbations of the fracture front caused by developing split lines. The fracture surface is often rough in bones broken when dry, and the fracture front often runs through epiphyses that are well packed with cancellous tissue. Both fresh and dry fractures occur early enough in taphonomic history to permit uniform discoloration of the fracture surfaces and the outer surfaces of the bone. Recent fractures, however, contrast markedly in color and are usually free of dirt. Otherwise they are similar to dry fractures in having rough surfaces and in passing through epiphyses.

Fresh-state fractures occur at or soon after the time of death. They may be deliberately induced by people to aid dismemberment of a carcass, to obtain marrow, to produce bone grease, or to fashion tools. Carnivores also fracture fresh bones while gnawing on them, and there are various stochastic processes such as trampling by large animals that may occasionally induce fractures in fresh bones. Human and carnivore behaviour probably account for nearly all fresh-state fractures at the Sjovold site. The locations of preserved impact points and tooth marks can assist in evaluating their relative importance. All fresh-state fractures are presumed to occur prior to desiccation and weathering and therefore represent perimortem, pre-burial modifications.

Table 5.6. Bison specimens from the Sjovold site.ᵃ

Skeletal Element	Left	Right	Axial/ Indet.	NISP/ Total	Fracture State				Cut	Burn	TMk	Weat	Etch
					Whole	Fresh	Dry	Recent					
Horn core (HCO)	2	-	2	4	-	-	4	-	-	-	-	-	1
Cranial bones (CRA)	1	2	12	15	-	-	15	-	-	1	-	-	9
Facial bones (FAC)	2	3	-	5	2	-	3	-	2	-	-	-	4
Maxilla (MAX)	5	8	1	14	-	2	12	-	-	-	-	-	11
Upper cheek teeth (UCH)	24	16	1	41	-	-	-	-	-	-	-	-	34
Mandible (MAN)	18	24	4	46	-	30	16	-	8	-	1	19	43
Incisors (INC)	1	2	26	29	-	-	-	-	-	-	-	2	24
Lower cheek teeth (LCH)	12	6	4	22	-	-	-	-	-	-	1	-	15
Cheek teeth, indet. (CTH)	-	-	2	2	-	-	-	-	-	-	-	-	-
Hyoid (HYO)	-	-	1	1	-	-	1	-	-	-	-	-	1
Atlas (ATL)	-	-	3	3	2	-	1	-	-	-	-	1	3
Axis (AXI)	-	-	1	1	-	-	1	-	-	-	-	-	1
Cervical (CER)	-	-	12	12	5	1	6	-	-	-	-	3	12
Thoracic (THO)	-	-	26	26	1	13	10	2	3	2	3	5	20
Lumbar (LUM)	-	-	19	19	1	16	2	-	1	-	1	4	12
Sacral (SAC)	-	-	1	1	-	1	-	-	-	-	-	-	1
Vertebra, indet. (VRT)	-	-	5	5	2	-	2	1	-	-	-	-	2
Rib (RIB)	22	20	62	104	1	49	34	20	9	-	10	57	93
Sternum (STE)	-	-	1	1	1	-	-	-	-	-	1	-	1
Scapula, blade (SCPb)	18	11	3	32	-	21	11	-	-	1	2	8	30
Scapula, distal (SCPd)	5	6	-	11	-	8	3	-	1	-	2	4	10
Humerus, proximal (HUMp)	1	2	-	3	-	1	2	-	-	-	1	-	2
Humerus, shaft (HUMs)	16	25	-	41	-	39	2	-	3	1	3	7	40
Humerus, distal (HUMd)	12	7	-	19	-	17	2	-	-	1	7	7	19
Radius, complete (RADc)	1	-	-	1	1	-	-	-	-	-	1	1	1
Radius, proximal (RADp)	12	9	-	21	-	17	4	-	-	-	2	5	21
Radius, shaft (RADs)	10	10	2	22	-	21	1	-	-	-	2	2	19
Radius, distal (RADd)	6	4	-	10	-	6	4	-	-	-	2	3	9
Ulna, proximal (ULNp)	3	-	-	3	-	1	2	-	-	1	1	2	3
Ulna, shaft (ULNs)	14	16	2	32	-	26	6	-	1	-	2	8	28
Ulna, distal (ULNd)	-	1	1	2	-	-	2	-	-	-	-	-	2
Radial carpal (RDL)	2	3	-	5	4	-	1	-	-	-	-	1	2
Intermediate carpal (INTC)	5	4	-	9	7	-	1	1	-	-	-	2	7
Ulnar carpal (ULR)	3	5	-	8	7	-	1	-	-	-	-	1	5
Accessory carpal (ACC)	1	3	-	4	3	-	1	-	-	-	-	-	4

Table 5.6 (continued).

Skeletal Element	Left	Right	Axial/ Indet.	NISP/ Total	Fracture State				Cut	Burn	TMk	Weat	Etch
					Whole	Fresh	Dry	Recent					
Carpal 2+3 (C23)	2	6	-	8	8	-	-	-	-	-	-	3	6
Carpal 4 (C4)	4	6	-	10	9	-	-	1	-	-	-	1	8
Metacarpal, complete (MCMc)	-	2	-	2	1	-	1	-	-	-	-	1	1
Metacarpal, proximal (MCMp)	1	7	-	8	-	6	2	-	-	-	-	5	8
Metacarpal, shaft (MCMs)	4	4	1	9	-	7	1	1	-	-	-	4	9
Metacarpal, distal (MCMd)	4	1	-	5	-	3	2	-	-	-	-	1	5
Metacarpal 5 (MC5)	1	-	-	1	1	-	-	-	-	-	-	-	1
Innominate (INN)	12	15	-	27	-	20	7	-	1	-	7	7	24
Femur, complete (FEMc)	-	1	-	1	1	-	-	-	-	-	1	1	1
Femur, proximal (FEMp)	2	-	1	3	-	3	-	-	-	-	3	2	3
Femur, shaft (FEMs)	17	15	5	37	-	36	1	-	-	2	1	4	34
Femur, distal (FEMd)	3	3	-	6	1	2	3	-	1	-	3	2	4
Patella (PAT)	-	1	-	1	1	-	-	-	-	-	1	-	1
Tibia, complete (TIBc)	-	1	-	1	1	-	-	-	-	-	1	1	1
Tibia, proximal (TIBp)	3	2	-	5	-	3	2	-	-	-	2	1	3
Tibia, shaft (TIBs)	30	22	2	54	-	52	2	-	2	1	2	8	52
Tibia, distal (TIBd)	12	7	-	19	1	16	2	-	2	-	1	9	19
Lateral malleolus (LMA)	8	5	-	13	12	-	1	-	-	1	-	2	10
Talus (TAL)	5	3	-	8	7	1	-	-	-	-	1	3	8
Calcaneus (CAL)	7	4	-	11	6	4	1	-	1	-	2	5	10
Tarsal C+4 (TC4)	6	5	-	11	11	-	-	-	-	-	-	2	10
Tarsal 1 (T1)	3	1	-	4	4	-	-	-	-	-	-	-	2
Tarsal 2+3 (T23)	4	6	-	10	9	-	1	-	-	-	-	2	10
Metatarsal 2 (MT2)	1	-	-	1	-	-	1	-	-	-	-	-	-
Metatarsal, proximal (MTMp)	2	9	-	11	-	10	1	-	-	-	1	3	10
Metatarsal, shaft (MTMs)	-	3	2	5	-	5	-	-	1	-	-	1	5
Metatarsal, distal (MTMd)	10	3	-	13	1	4	8	-	-	-	-	4	11
First phalanx (PH1)	15	14	2	31	19	4	6	2	-	-	-	3	28
Second phalanx (PH2)	8	6	2	16	12	-	3	1	-	1	-	2	12
Third phalanx (PH3)	6	6	-	12	5	1	6	-	-	-	1	-	11
Prox-med sesamoid (PMS)	-	-	12	12	7	-	5	-	-	-	-	1	5
Prox-lat sesamoid (PLS)	-	-	9	9	9	-	-	-	-	-	1	2	3
Distal sesamoid (DSS)	-	-	2	2	1	-	1	-	-	-	-	-	1
Total	366	345	229	940	164	446	207	29	36	12	70	222	805
Percent	38.9	36.7	24.4	100.0	19.4	52.7	24.5	3.4	3.8	1.3	7.4	23.6	85.6

a. TMk, tooth-marked; Dig. digested; Weat, weathered; Etch, root-etched.

Dry-state fractures may be induced by human and carnivore activity, subaerial weathering and trampling so long as bones remain on the surface. After burial the effects of trampling may continue in shallow sub-soil, causing dispersal as well as additional fragmentation (Gifford-Gonzalez, et al. 1985). Additional diagenetic effects are poorly understood but might include fragmentation as a result of wet-dry and freeze-thaw cycling. Very deep burial may lead to fragmentation from sediment loading, but we doubt that this is an important factor at the Sjovold site. Recent fractures are caused by excavation techniques that are too vigorous, and at Sjovold they are common only in samples recovered by shovel and screen. A few additional fractures have occurred during shipping and handling.

All bones that can be classified as to general or specific anatomical part are coded for fracture state, but teeth and unclassifiable fragments are not coded. Tooth fractures cannot be characterized by the terms used for bones, and unclassifiable fragments are simply too numerous, and often too small, to permit reliable observations.

Cut marks are recognized by criteria developed by several researchers (Walker and Long 1977; Shipman and Rose 1983). In the Sjovold site they are slender, usually straight, and they do not follow irregularities in the bone surface; they are deeper on high spots and shallower on low spots. Fine-scale striations can be seen on the walls of cut marks at high magnification, and their placement on bones is usually sensible with regard to tasks such as dismemberment or defleshing. Cut marks are coded as single or multiple incisions or scrapes with placement and orientation also recorded. The separation of perimortem cut marks from recent trowel marks is aided by noting superpositions with other bone modifications as well as differences in the mark characteristics. Trowel marks are relatively broad, lack striated walls and adhering sediment, and truncate or bifurcate marks made by plant rootlets. Trowel mark placement is random and seldom similar to cut mark placement.

Burning is recorded as charring (part or all black) and calcining (part or all white). It is distinguished from other discolorations by the penetration of surfaces that are often checkered by shrinkage (Shipman, et al. 1984; Nicholson 1993). "Charred" bones generally correspond to Nicholson's (1993) heating stages 1 and 2, and "calcined" bones to stages 3 and 4. The most common discoloration that could be confused with burning in the Sjovold site is from calcium carbonate coating, but the latter is clearly a coating that can usually be chipped off with forcep tips. Such diagenetic coatings can obscure other modifications such as cut marks and rootlet etching.

Tooth marks are recorded as punctures, scrapes, furrows or grooves (see Bonnichsen and Will 1980; Haynes 1983). They have been compared with documented reference specimens, and most instances at Sjovold are attributed to carnivores, mainly canids, and a few to rodents. Evidence of digestion is seen in the form of shallow pitting and thinning of bone surfaces, rounding of edges, and included or adhering fecal material (see Rensberger and Krentz 1988; Andrews 1990; Schmitt and Juell 1994). Included fecal material is often tightly packed in the cells of cancellous tissue, and some fragments are smeared with adhering feces. These specimens have been compared with bone fragments recovered from dog regurgitant and excrement, and they are identical in every respect. A few small mammal bones exhibit local thinning of prominences that matches the digestive effects seen in freshly regurgitated raptor pellets. Such thinning occurs, even in owls, wherever a bone protrudes beyond the protective cover of feathers or hair and comes into contact with the mucosa in the proventriculus and esophagous.

All of these carnivore and raptor effects occur in the perimortem, pre-burial stage of taphonomic history. Raptors, and to some extent carnivores, may be major agents in introducing species to the site assemblage, and scavenging carnivores can significantly alter both individual bones and the patterning of a bone assemblage (Binford and Bertram 1977; Blumenschine 1988; Haynes 1980a, 1980b, 1983; Hockett 1989; Hoffman 1988; Kent 1981; Korth 1979; Kusmer 1990; Mayhew 1977). There are marked variations in the importance of such effects during the occupational history of the Sjovold site.

Weathering is recorded in terms of stages defined by Behrensmeyer (1978). Most Sjovold bones exhibit little or no weathering (Stage 0), and the most advanced example is classified as Stage 3. Among weathered bones, most exhibit merely the formation of split lines on shafts and mosaic cracking on articular surfaces (Stage 1), but some are more deeply cracked with exfoliation beginning (Stage 2). We presume that these weathering effects take place in the sub-aerial environment and that their degree of development may reflect elapsed time before burial. Although it is usually assumed that "burial halts the process of subaerial weathering" (Potts 1986:26; also Stern 1993:208-209), A.K. Behrensmeyer and P. Shipman have expressed the opinion that deterioration similar to the effects of weathering can continue subsequent to burial (see Jodry and Stanford 1992:111); we are unaware of any empirical data on this point. We

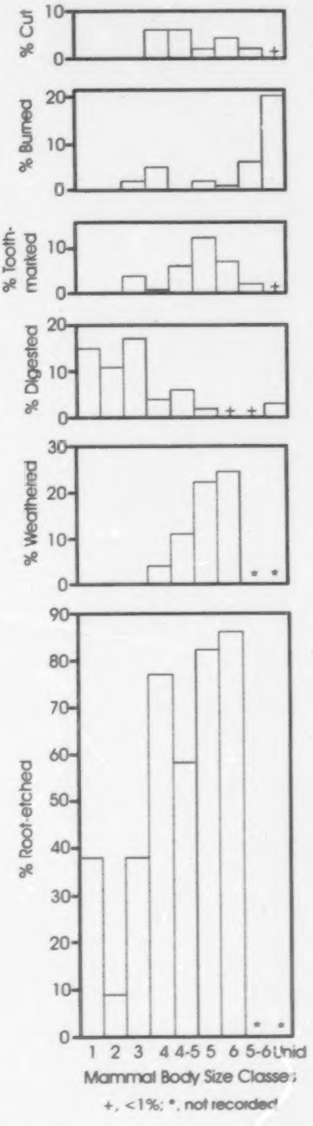


Figure 5.4. Percentage NISP by mammal body size exhibiting six kinds of bone modification.

suspect that the deep, relatively moist burial environments of the Sjovold site would differ considerably from the shallow, dry, sandy sediments of the Stewart's Cattle Guard site where this question was posed to Behrensmeyer and Shipman.

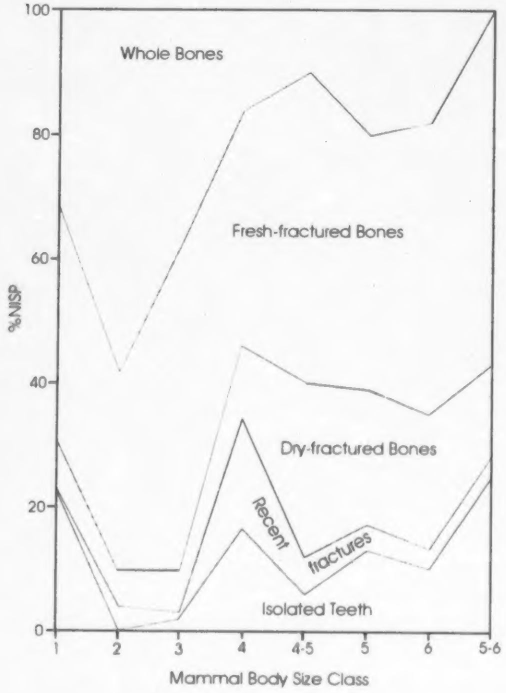


Figure 5.5. Percentage NISP by mammal body size exhibiting various fracture states.

Etching by rootlets is commonplace in the Sjovold site and may be so advanced as to obscure other surface modifications. Rootlet tracks are relatively broad in relation to their depth, and their depth remains uniform across irregular surfaces. Often one can see a dendritic pattern that represents the anastomosing rootlet tip. Occasionally small segments of rootlet are still preserved in the tracks, and a few of these are associated with a reddish stain that resembles red ochre. Several bones thought initially to be ochre-stained are now interpreted as merely rootlet-etched. Although primarily associated with the burial environment, it is possible that rootlet etching begins in dense surface vegetation prior burial by sediment. Rootlet etching may continue long after deep burial, because living grass roots commonly extend a meter or more below the surface (Coupland and Brayshaw 1953.401). The chemistry of root exudates is very complex (Bokhari, et al. 1979), and the mechanisms involved in bone modification are poorly understood.

Bone colour has not been systematically recorded, but it was carefully observed. None of the bones has the colour of a freshly dissected or macerated bone, and the current colour represents modification by organic and/or mineral staining. Most of the bones are pale tan or buff-coloured, like the enclosing sediment, and a few specimens collected from the Test Profiles have been bleached white by exposure to the sun. In some samples, bones with more saturated yellow-brown and red-brown hues offer conspicuous contrasts to the usual colours, and such variations may signal differences in taphonomic history. Given the pale tan colour of most of the bones, it is quite easy to recognize charred and calcined specimens.

All of the foregoing results of bone modification are considered, along with anatomical representation, age, sex, taxonomic identification, and life history data, to reconstruct taphonomic histories for the recovered vertebrate remains. We presume that the Sjovold site contains skeletal elements representing a wide array of processes among which human subsistence and technological practices are merely the most conspicuous. We can show that carnivorous mammals and raptorial birds also contributed to the faunal assemblage by expelling scats and pellets on the Sjovold site, and some animals (e.g. a toad) may have expired there during hibernation. Several taxa, including toad, ground squirrel and badger, appear to have burrowed into the site deposits. Therefore some of the bones can be considered intrusive into the layers from which they were recovered, and a careful taphonomic analysis can help to identify such intrusive elements (Semken and Falk 1991; Whyte 1991; Shaffer 1992; Shaffer and Neely 1992; Sobolik 1993; Morlan 1993b, 1994a).

Taphonomic histories are reconstructed for each taxon in Chapters 6-25 where the site context is revealed to be an important variable. The summary data given in Table 5.5 by mammalian body size class also reveals patterns of interest. For example, most kinds of bone modification do not occur uniformly among the body size classes (Fig. 5.4). Cut marks are present only on mammals of size 4 and larger, and burning is not seen on bones of mammals smaller than size class 3. Tooth-marking is present on all but the two smallest classes, the latter representing animals that can be injested whole by some of their predators. Conversely evidence of digestion by both carnivores and raptors is concentrated among the smallest three classes, reflecting the fact that only the smallest bones of large mammals can be injested by predators and scavengers. The frequency of weathering is directly related to body size, because larger bones have greater "weathering profile height" (see Rapson 1990: 203) whereas smaller ones can be protected by vegetation and are more readily buried. Root-etching is nearly ubiquitous on bones in the larger size classes. Its relative scarcity on the bones of smaller mammals reflects both the reduced surface area of the bones and the fact that small mammals are more often intrusive into the site than larger ones.

Large and small mammal bones also differ with respect to fracture state (Fig. 5.5). For size classes 4-6 fewer than 20% of the bones are whole, and nearly half have been fractured when fresh. There are no whole bones in size class 5-6, because this class consists of unidentified large mammal bone and tooth fragments. The larger size classes also contain many dry-fractured bones that presumably reflect more advanced weathering as well as diagenetic processes such as trampling. In contrast most bones in size classes 1-3 either are whole or have been fractured while fresh. Isolated teeth are shown as a separate category in Figure 5.5, because their fracture properties differ from those of bones.

The Sjovold Bison Assemblage

Of 1287 vertebrate specimens identified to family, genus or species at the Sjovold site, 940 (73%) represent bison. The bison bones are presented in detail in Chapters 6-25 where variable but usually small sample sizes tend to obscure patterns of anatomical representation and bone modification. Some of these patterns are seen more clearly when the whole assemblage is considered as a single aggregate. The number of identified specimens (NISP) is the fundamental quantitative measure of any faunal analysis, and all other measures are functions of NISP. However, NISP is not a fully adequate measure, because it fails to distinguish between 10 bones of one animal and one bone from each of ten animals (Grayson 1984; Ringrose 1993). Likewise, it makes no distinction between 10 fragments of one bone and one fragment from each of ten bones. The measure most frequently derived from NISP is the minimum number of individuals (MNI), but we consider MNI to be inappropriate for understanding the Sjovold site. In addition to general problems concerning aggregation affects (see Grayson 1984), there are two site-specific reasons for avoiding the use of MNI at Sjovold: (1) since the excavated area includes only a small part of the site at any given occupation layer, each faunal assemblage represents an unknown but variable sample of the total amount of faunal material introduced during the occupation; and (2) we suspect that many of the occupation events represent small transitory groups (Dyck 1993) carrying food supplies procured elsewhere as well as locally. Thus the recovery of two left humeri, say, does not indicate that two bison were brought to the site; it means only that two portions containing humeri were brought there. We cannot know whether the right humeri were left behind or whether they lie just beyond the excavation limits. Therefore the distinction between left and right is not generally helpful in this analysis, and we mention side only when suggesting that a particular individual animal is the source of two or more recovered specimens.

Our preferred measure is the minimum number of elements (MNE) and its derivative, minimum animal units (MAU). Since nearly equal numbers of left and right specimens were recovered (Table 5.6), MAU gives a close approximation of MNI for any given anatomical element. MNE and MAU are subject to the same aggregation effects for which MNI is criticized, but we have dampened these effects in two ways: (1) we use the entire excavated area as the aggregate for any given layer so that the treatment is uniform among the layers; and (2) we base the count of MNE on the frequencies of defined, named element portions (Morlan 1994b). The highest portion count gives the MNE for its element when considering the site as a whole. MAU is calculated by dividing MNE by its anatomical frequency. For cheek teeth and appendicular elements, MAU = MNE/2. The divisor is quite variable for other elements: incisors (8), atlas (1), axis (1), other cervical vertebrae (5), thoracic vertebrae (14), lumbar vertebrae (5), and ribs (28). Some element portions occur in pairs, e.g., lumbar transverse spines for which MAU = MNE/(5*2). Teeth and their alveoli are counted separately, and the higher frequency, if they differ, is taken as the MNE for that portion.

The use of named portions enables us to identify patterns of bone fragmentation among the layers of the Sjovold site as well as patterning in the placement of bone modifications across the entire assemblage. It also offers a convenient method of examining the influence of volume density on bone survivorship by matching the portions with density scan sites measured on deer by Lyman (1984) and on bison by Kreutzer (1992). Thus the role of volume density in conditioning element frequencies can be examined among the fragments of a given element as well as among all elements for the assemblage as a whole. We believe that this approach will eventually form a sound basis for comparative faunal analysis (Morlan 1994b).

Bison Fragmentation and Survivorship

Each major element of the bison skeleton is summarized in terms of named portions, showing distributions by layer, site-wide MNE, MAU, and %MAU, locations of bone modifications, and variations in volume density as reported by Kreutzer (1992). Portions are defined using terminology found in Balkwill and Cumbaa (1992), Brown and Gustafson (1979), Todd and Rapson (1988), and von den Driesch (1976), and summarized by Morlan (1994b). A given specimen can exhibit many portions, and a complete element contains all of them. Since the portions are usually diagnostic features used to identify a fragment, it is rare for an identified specimen to lack them; the few exceptions include molar or premolar fragments that cannot be assigned to position in the tooth row, or fragments of scapula blade that lack their original borders.

Skull. Rather than attempting a comprehensive list of skull portions, we list only those that are recognized in the Sjovold site assemblage (Table 5.7). From posterior to anterior they include the occipital condyle, tympanic bulla, basisphenoid, horn core, zygomatic, six permanent and two deciduous teeth and their alveoli, and the premaxilla. Large dense molars and the very dense tympanic bulla are the most abundant portions, but it is noteworthy that in two components the rather gracile premaxilla is the only skull portion recovered. It may also be noteworthy that maxillary deciduous teeth are fairly common whereas only one deciduous mandibular tooth was found. Perhaps calf heads containing the brains were brought to the site without the mandibles.

Mandible. We recognize 21 portions on the bison mandible (Table 5.8). Listed from posterior to anterior, they are the articular condyle, coronoid process, mandibular foramen, angle, each cheek tooth, each cheek tooth alveolus, lower border, diastema, symphysis, incisor(s) including the incisiform canines, and incisor alveoli as a group. The lower border is a zone rather than a discrete feature, and a given specimen might yield more than one recognizable fragment. However, through hands-on matching of fragments we have been careful to avoid counting any element more than once, and the small sample from any given layer usually presents no ambiguity in this regard.

Mandibles are best represented by the symphysis and diastema, and most of the recognizable impact scars, as well as several cut marks, are associated with these areas. Cut marks beneath the symphysis and directly below the anterior premolars have been attributed to skinning (Binford 1981: Table 4.04, M-1; Frison, et al. 1976:50), but the Sjovold examples are directly beneath the diastema and are associated with impact scars on the same specimens (Fig. 5.6). We suspect that they represent a method of tongue removal whereby both hemimandibles are broken through the diastema and the symphysis pulled downward so that the tongue can be retrieved still attached to the genioglossus muscle that originates on the mandible (e.g. Pansky and House 1969: Plate 22). A second cluster of impact scars and cut marks is found on the ascending ramus (Fig. 5.6). The impact scars are

Table 5.7. Portions of the bison skull, posterior to anterior.

Portions:[a]	OCN	BUL	BSP	HCO	ZYG	M3	M2	M1	P4	dP4	P3	dP3	P2	PMX
Layers (NISP)														
III (4)	-	-	-	-	-	-	-:1	-:1	-:1	-	-:1	-	-	-
VI (6)	-	4	-	-	-	-	-	-:1	-	-	-	-:1	-	-
VIII + IX (4)	-	-	-	-	-	-	-:1	-:1	-	-:1	-	-:1	-	-
IX (1)	-	-	-	1	-	-	-	-	-	-	-	-	-	-
X (22)	-	3	-	1	-	-	2:2	2:4	2:4	-:2	2:4	-:2	1:6	-
XI (5)	-	1	-	-	-	-	-:1	-	-	-	-:1	-	-:2	-
XII (7)	-	1	-	-	-	1:2	1:2	-:2	-	-	-	-	1:1	-
XII/XIII (3)	-	-	-	-	1	1:1	1:1	1:1	1:1	-	1:1	-	1:1	-
XIII (2)	-	-	-	-	-	-	-	1:1	-	-	-	-	-	-
XIV (17)	-	3	-	3	-	2:2	2:3	-:1	-:1	1:1	-:1	-:1	-:1	-
XIV/XV (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	1
XVI (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	1
XVI/XVII (2)	-	-	-	-	2	-	-	-	-	-	-	-	-	-
XIX (5)	1	-	-	-	1	1:1	1:3	-	-	-	-	-	-	-
XXI (1)	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Total (81)														
MNE	1	12	1	5	4	5:6	7:14	4:12	3:7	1:4	3:8	0:5	3:11	2
MAU	0.5	6.0	1.0	2.5	2.0	3.0	7.0	6.0	3.5	2.0	4.0	2.5	5.5	1.0
%MAU	3.4	41.4	6.9	17.2	13.8	20.7	48.3	41.4	24.1	13.8	27.6	17.2	37.9	6.9
Modifications														
Cut marks	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Charred	-	1	-	-	-	-	-	-	-	-	-	-	-	-

a. OCN, occipital condyle; BUL, tympanic bulla; BSP, basisphenoid; HCO, horn core; ZYG, zygomatic arch; Teeth (M3, M2, M1, P4, dP4, P3, dP3, P2), alveolus:tooth; PMX, premaxilla.

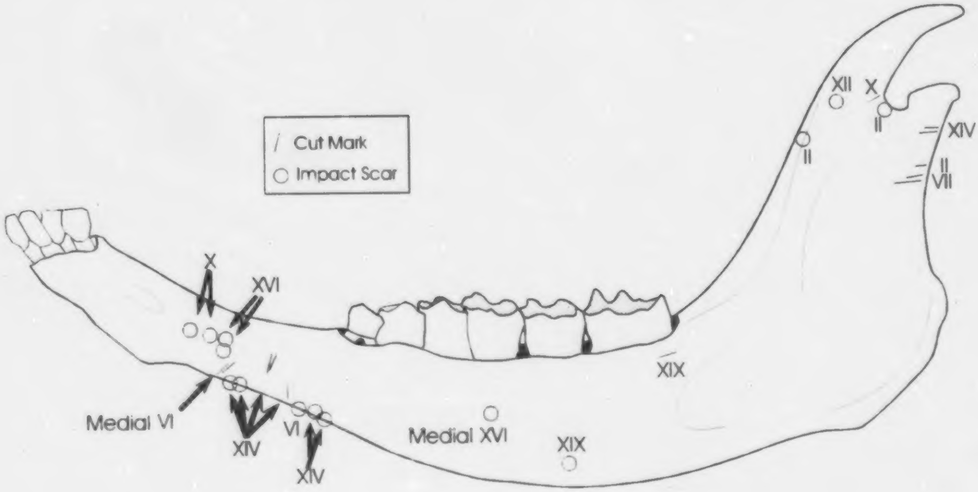


Figure 5.6. Locations of cut marks and impact scars on bison mandibles from the Sjovold site.

associated with breaks through the base of the coronoid process, which is under-represented in the site, and the cut marks would have severed ligaments and muscles that hold the mandible on the skull. An isolated cut mark near M_3 would have weakened the insertion of the masseter muscle and aided dismemberment (see Binford 1981: Table 4.04, M-4), and two impact scars below the molars would have opened the pulp cavity of the mandible (see Frison, et al. 1976:60).

Mandible fragments occur in 19 of the 33 numbered layers and interlayers with their highest concentrations (NISP > 10) in Layers X, XI, and XIV. Kreutzer (1992) scanned eight sites to measure the volume density of bison mandibles. Her measurements are negatively correlated with the frequencies of the corresponding portions ($r = -0.10$), but the relationship is not statistically significant.

Axial Elements. The axis, sacrum and sternum, each represented by one specimen, are notably scarce, and caudal vertebrae are completely absent having, perhaps, been carried away in skins or else consumed by scavengers. Vertebrae are greatly under-represented in the Sjovold site, with 67 specimens scattered among 16 layers and interlayers with a maximum concentration in Layer XIX (NISP=18). The atlas represents the maximum MAU (3.0, 20.7%). The other cervical vertebrae have their maximum MAU (2.0, 13.8%) from the centrum whereas the thoracic and lumbar vertebrae are represented mainly by neural spines (1.07, 7.4%) and transverse spines (1.1, 7.6%), respectively. Cut marks are seen only on these spines which are broken off in order to retrieve the hump meat and the

Table 5.8. Portions of the bison mandible, posterior to anterior.

Portions:[a]	AC	CP	MF	AN	M3	M2	M1	P4	dP4	P3	P2	LB	DS	SY	I
Layers (NISP)															
II (2)	1	-	1	1	1:1	1:1	-	-	-	-	-	1	-	-	-
III (3)	-	-	-	-	-:1	-:1	-	-	-	-	-	-	-	-	-
VI (1)	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-
VII (3)	-	-	1	1	-	-	-	-:1	-	-	-	-	-	-	-
VIII+IX (1)	-	-	-	-	-	-:1	-	-	-	-	-	-	-	-	-
IX (2)	-	-	-	-	1:1	-	-	-	-	-	-	-	-	-	-:1
X (18)	1	1	1	1	2:3	2:3	1:1	1:1	-:1	2:3	2:2	3	5	6	8:3
XI (14)	-	-	-	-	2:2	2:2	2:2	2:2	-	2:3	2:1	-	2	2	1:10
XII (9)	1	1	1	-	-:1	-	-	-	-	-	-:1	1	1	1	-:3
XII/XIII (5)	1	-	1	-	-	-	-:1	-	-	-	-	-	-	1	2:3
XIII (6)	-	-	-	-	-:1	-:2	-	-	-	-:1	-	1	1	1	4:1
XIII/XIV (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
XIV (19)	4	1	4	-	1:1	2:2	1:1	-	-	-	-	3	4	3	8:6
XIV/XV (2)	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-:1
XVI (2)	-	-	-	-	-	-	-	-	-	-	-	-	2	2	8:-
XVI/XVII (1)	-	-	-	-	1:1	1:1	1:1	1:1	-	1:1	-	-	-	-	-
XVII (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-:1
XIX (3)	-	-	-	-	1:1	1:1	1:1	-	-	-	-	2	-	-	-
XXI (4)	-	-	-	-	-	-:1	-:1	-	-	-	-	-	-	-	-:1
Total (97)															
MNE	8	3	9	3	9:13	9:15	6:8	4:5	-:1	5:8	4:4	12	16	17	31:30
MAU	4.0	1.5	4.5	1.5	6.5	7.5	4.0	2.5	0.5	4.0	2.0	6.0	8.0	8.5	3.9
%MAU[b]	27.6	10.3	31.0	10.3	44.8	51.7	27.6	17.2	3.4	27.6	13.8	41.4	55.2	58.6	26.9
Modifications															
Impact scars	-	1	1	-	-	-	2:-	-	-	-	-	4	3	-	-
Cut marks	-	1	3	-	1:-	-	-	-	-	-	-	1	2	-	-
Tooth marks	-	-	-	-	1:-	-	-	-	-	-	-	-	-	-	-
Density (Kreutzer 1992)															
Volume density (VD)[b]	-	0.79	0.79	0.57	-	0.49	0.53	-	-	0.62	-	-	0.61	0.53	-
Scan site	-	DN8	DN7	DN6	-	DN5	DN4	-	-	DN3	-	-	DN2	DN1	-

a. AC, articular condyle; CP, coronoid process; MF, mandibular foramen; AN, angle; Teeth (M3, M2, M1, P4, dP4, P3, P2), alveolus:tooth; LB, lower border; DS, diastema; SY, symphysis; I, incisor alveolus:tooth. b. Rank-order correlation, %MAU vs. VD: $r=-0.10$, $P>0.05$.

Table 5.9. Portions of the bison scapula, proximal to distal.

Portions:[a]	SBp	IBp	NF	SP	AC	SBd	IBd	Nk	CP	GC
Layers (NISP)										
VI (3)	-	1	1	1	-	1	1	-	-	-
VII (1)	-	-	-	1	1	1	1	1	1	1
VIII+IX (2)	-	-	1	-	-	-	1	1	-	1
X (4)	-	2	1	3	-	2	1	1	1	1
XI (5)	3	-	-	4	-	2	1	1	1	1
XII/XIII (2)	1	1	1	1	-	1	1	-	-	-
XIII (3)	-	-	-	1	-	-	1	-	-	-
XIV (4)	1	-	-	3	-	1	2	1	1	1
XVI (1)	-	-	1	1	1	1	1	1	1	1
XIX (12)	2	1	2	4	-	3	5	2	1	3
XX/XXI (1)	-	-	-	-	-	1	-	-	-	-
XXI (5)	1	1	-	2	1	3	-	1	1	2
Total (43)										
MNE	8	6	7	21	3	16	15	9	7	11
MAU	4.0	3.0	3.5	10.5	1.5	8.0	7.5	4.5	3.5	5.5
%MAU[b]	27.6	20.7	24.1	72.4	10.3	55.2	51.7	31.0	24.1	37.9
Modifications										
Impact scars	-	-	-	1	-	3	7	-	-	-
Cut marks	-	-	-	-	-	-	-	-	-	1
Charred	-	-	-	1	-	-	-	-	-	-
Tooth marks[c]	-	-	-	-	-	^{1J}2	^{J}1	-	-	2
Pathology	-	-	-	1	-	-	-	-	-	-
Density (Kreutzer 1992)										
Volume density (VD)[b]	0.28	0.17	0.43	0.48	-	-	-	-	-	0.50
Scan site	SP3	SP5	SP4	SP2	-	-	-	-	-	SP1

a. SBp, proximal superior border; IBp, proximal inferior border; NF, nutrient foramen; SP, spine; AC, acromion; SBd, distal superior border; IBd, distal inferior border; Nk, neck; CP, coracoid process; GC, glenoid cavity. b. Rank-order correlation, %MAU vs. VD: r=0.80; P>0.05. c. J, Juvenile specimens.

tenderloins. There are very few rib heads, but there are long pieces of rib shaft reflecting retrieval of rib slabs that are valued for both meat and fat.

Scapula. Forty-three scapula specimens are found in only 12 layers and interlayers with a maximum frequency in Layer XIX (NISP=12). Scapula fragments are recorded as proximal or distal portions of the superior or inferior borders, as spines, or as glenoid fossas (Table 5.9). The frequencies of these portions are positively correlated with volume density (r = 0.80), but the relationship is not statistically significant. Distal border portions often preserve recognizable impact scars. The only observed cut mark reflects dismemberment (Binford 1981: Table 4.04, S-1). Tooth marks are confined to the distal end, and they penetrate the main blade of the scapula only in a

Table 5.10. Portions of the bison humerus, proximal to distal.

Portions:[a]	LT	MT	H	PS	DT	TT	PLF	POF	CF	LE	ME	LC	MC
Layers (NISP)													
I (1)	-	-	-	1	-	-	-	-	-	-	-	-	-
II (1)	-	-	-	-	-	-	-	1	1	1	1	1	1
III (2)	-	-	-	-	-	1	1	1	1	-	-	-	-
IV-V (1)	-	-	-	-	-	1	-	-	-	-	-	-	
VI (3)	-	-	-	-	-	-	-	1	3	1	1	2	3
VII (3)	-	-	-	-	-	-	-	1	1	1	1	1	1
VIII+IX (2)	-	-	1	-	-	-	-	-	-	-	-	-	1
X (12)	-	-	-	-	1	1	2	3	6	3	2	2	1
XI (8)	-	-	1	1	4	1	-	2	1	1	1	1	1
XII (2)	-	-	-	-	2	-	-	-	1	-	-	-	-
XII/XIII (2)	-	-	-	-	1	2	2	2	2	2	2	2	2
XIII (4)	-	-	-	1	1	1	-	1	-	-	-	-	-
XIV (9)	1	-	-	-	3	3	2	2	3	2	2	2	2
XIV/XV (1)	-	-	-	-	1	-	-	-	-	-	-	-	-
XV (1)	-	-	-	-	1	-	-	-	-	-	-	-	-
XVI (1)	-	-	-	-	-	1	1	1	1	1	1	1	1
XVI/XVII (1)	-	-	-	-	-	-	-	1	-	-	-	-	-
XVII (2)	-	-	-	-	1	1	-	-	-	-	-	-	-
XVIII (1)	-	-	-	1	-	-	-	-	-	-	-	-	-
XIX (5)	-	-	-	-	1	2	1	1	1	-	-	-	1
XXI (1)	-	-	-	-	-	1	-	-	-	-	-	-	-
Total (63)													
MNE	1	0	2	4	16	15	9	17	21	12	11	12	14
MAU	0.5	0.0	1.0	2.0	8.0	7.5	4.5	8.5	10.5	6.0	5.5	6.0	7.0
%MAU[b]	3.4	0.0	6.9	13.8	55.2	51.7	31.0	58.6	72.4	41.4	37.9	41.4	48.3
Modifications													
Impact scars	-	-	-	1	11	11	3	8	7	3	1	-	-
Cut marks	-	-	-	-	-	2	-	1	-	-	-	-	-
Charred	-	-	-	-	-	1	-	-	-	-	-	-	1
Chopper bits	-	-	-	-	-	2	-	-	-	-	-	-	-
Tooth marks[c]	-	-	1	1	-	-	-	-	J2	2	-	3	3
Density (Kreutzer 1992)													
Volume density (VD)[b]	-	-	0.24	-	0.25	0.45	-	-	0.48	-	-	-	0.38
Scan site	-	-	HU1	-	HU2	HU3	-	-	HU4	-	-	-	HU5

a. LT, lateral tuberosity; MT, medial tuberosity; H, head; PS, proximal shaft; DT, deltoid tuberosity; TT, teres tuberosity; PLF, postero-lateral foramen; POF, proximal olecranon fossa; CF, coronoid fossa; LE, lateral epicondyle; ME, medial epicondyle; LC, lateral condyle; MC, medial condyle. b. Rank-order correlation, %MAU vs. VD: $r=0.70$; $P>0.05$. c. J, Juvenile specimens.

Table 5.11. Portions of the bison radius, proximal to distal.

Portions:[a]	LGC	MGC	PPS	RT	PLF	MPS	MAS	DPS	DAS	RCF	ICF
Layers (NISP)											
III (2)	-	-	-	-	-	-	-	1	-	-	1
VI (1)	1	-	1	-	-	-	-	-	-	-	-
VII (2)	1	1	1	1	-	-	-	1	1	1	1
VIII+IX (1)	1	-	1	1	1	1	1	-	-	-	-
X (7)	1	2	2	1	1	1	-	3	3	4	4
XI (7)	2	4	2	3	1	1	3	-	-	-	1
XII (1)	-	-	-	-	-	-	-	-	-	-	1
XIII (6)	1	3	3	2	1	-	2	-	-	-	-
XIV (9)	2	3	3	4	2	4	7	1	1	1	1
XIV/XV (2)	1	2	1	2	1	1	1	1	1	-	-
XVI (1)	-	-	-	-	-	-	-	1	1	1	1
XIX (14)	4	4	4	5	2	5	4	-	-	-	-
XXI (1)	1	-	1	-	-	-	-	-	-	-	-
Total (54)											
MNE	15	19	19	19	9	13	18	8	7	7	10
MAU	7.5	9.5	9.5	9.5	4.5	6.5	9.0	4.0	3.5	3.5	5.0
%MAU[b]	51.7	65.5	65.5	65.5	31.0	44.8	62.1	27.6	24.1	24.1	34.5
Modifications											
Impact scars	-	-	1	8	-	-	11	-	1	-	-
Tooth marks[c]	$^{2J}3$	$^{J}1$	$^{2J}2$	$^{J}1$	$^{1J}2$	$^{J}2$	$^{J}2$	-	1	-	1
Density (Kreutzer 1992)											
Volume density (VD)[b]	-	0.48	-	0.56	-	-	0.62	0.42	-	-	0.35
Scan site	-	RA1	-	RA2	-	-	RA3	RA4	-	-	RA5

a. LGC, lateral glenoid cavity; MGC, medial glenoid cavity; PPS, proximal-posterior shaft; RT, radial tuberosity; PLF, postero-lateral foramen; MPS, mid-posterior shaft; MAS, mid-anterior shaft; DPS, distal-posterior shaft; DAS, distal-anterior shaft; RCF, radial carpal facet; ICF, intermediate carpal facet. b. Rank-order correlation, %MAU vs. VD: $r=0.58$; $P>0.05$. c. J, Juvenile specimen(s).

juvenile specimen.

One spine exhibits a pathology consisting of an oval pit about 10 mm long, 7 mm wide and 5 mm deep. The walls of the pit are somewhat porous, and reactive bone growth is present around its edges. The pit appears to have been a cyst resulting from injury, but the injury healed before death. From its size and position the injury might have been caused by goring.

Humerus. The 63 humerus specimens, none of them complete, are scattered among 21 layers and interlayers, reaching a maximum in Layer X (NISP=12). Portions on the humerus include the proximal end (head, lateral and medial tuberosities), proximal shaft (or neck), deltoid tuberosity, teres tuberosity, postero-lateral foramen, proximal olecranon fossa, coronoid fossa, and distal end consisting of lateral and medial condyles and epicondyles (Table 5.10). The distal end is seven times more abundant than the proximal end, and several shaft portions have higher frequencies than the distal end. Correlation with volume density is positive ($r = 0.70$) but not statistically significant. Impact scars are scattered along the shaft, but tooth marks are confined to the ends of the bone. Two juvenile specimens have lost their distal ends to gnawing that reaches into the coronoid fossa. The three observed cut marks do not correspond exactly to patterns reported elsewhere, but two of them (teres tuberosity) are probably related to filleting and the third to dismemberment. Two fragments bearing the teres tuberosity are extensively chipped and polished along edges that may have served as humerus choppers, and there is no sign of gnawing on these bones.

Radius. One complete and 53 fragmentary radii are found in only 13 layers and interlayers with a maximum in Layer XIX (NISP=14). Named portions (Table 5.11) include, from proximal to distal, the proximal end (lateral and medial glenoid cavities), proximal posterior shaft (lacking contact with the ulna), radial tuberosity, posterolateral foramen, mid-posterior shaft (where in contact with ulna), mid-anterior shaft (a broad biconvex featureless surface), distal posterior shaft (lacking contact with the ulna), distal anterior shaft (marked by two prominent longitudinal ridges), and distal end including the radial and intermediate carpal facets, often fused to the ulnar styloid process. The frequencies of these portions are not significantly correlated with volume density ($r = 0.58$).

Impact scars are found only on the anterior surface where the ulna cannot interfere with the blow. Only seven specimens are tooth-marked, but evidence of gnawing appears at many locations because of two juvenile shaft cylinders that have been shortened but not collapsed by gnawing.

Ulna. Given the close articulation and potential for fusion between the radius and ulna, we expected to find their occurrences highly correlated in the Sjovold site. The 37 ulna fragments are scattered among 16 layers and interlayers, including four layers that lack radius fragments. Three of the latter consist of articular facets that must have entered the site attached to radius fragments that were destroyed by processing or deposited outside the excavation area. Ulnar portions, from proximal to distal, are the olecranon process and its epiphysis, anconeal process, articular facets, proximal shaft (not in contact with radius), mid-shaft (in contact with radius), and styloid process (Table 5.12). The

Table 5.12. Portions of the bison ulna, proximal to distal.

Portions:[a]	Pe	OP	AP	AF	PS	MS	SP
Layers (NISP)[b]							
II (1)	-	-	1	1	-	-	-
III (1 RAD)	-	-	-	-	-	-	1
IV-V (1)	-	-	1	1	-	-	-
VII (1 + 1 RAD)	-	-	1	1	-	-	1
VII/VIII (1)	-	-	-	-	-	1	-
VIII/IX (1)	-	-	-	-	1	1	-
X (5 + 4 RAD)	-	-	2	2	1	2	5
XI (6 + 1 RAD)	1	2	4	2	2	3	1
XIII (1)	-	-	-	-	1	1	-
XIV (6 + 1 RAD)	-	-	3	2	2	4	2
XVI (1 RAD)	-	-	-	-	-	-	1
XVI/XVII (1)	-	-	-	-	-	1	-
XVII (1)	-	-	-	-	-	1	-
XVIII (1)	-	-	-	1	1	-	-
XIX (9)	1	1	2	4	2	3	-
XXI (2)	-	-	-	1	-	1	-
Total (37 + 9 RAD)							
MNE	2	3	14	15	10	18	11
MAU	1.0	1.5	7.0	7.5	5.0	9.0	5.5
%MAU[c]	6.9	10.3	48.3	51.7	34.5	62.1	37.9
Modifications							
Impact scars	-	1	-	-	-	-	-
Cut marks	-	-	-	-	-	1	-
Charred	-	1	-	-	-	-	-
Tooth marks	-	1	2	-	-	-	-
Density (Kreutzer 1992)							
Volume density (VD)[c]	-	0.34	-	0.69	0.56	0.62	0.35
Scan site	-	UL1	-	UL2	RA2	RA3	RA5

a. Pe, proximal epiphysis; OP, olecranon process; AP, anconeal process; AF, articular facets; PS, proximal shaft; MS, mid-shaft; SP, styloid process. b. Some styloid processes are portions of distal radii that are counted among the radius specimens. c. Rank-order correlation, %MAU vs VD: $r=0.80$; $P>0.05$.

scarcity of the olecranon process suggests that it may have been broken off during primary butchering (e.g. Frison, et al. 1976: Fig. 17, no. 3), although carnivore gnawing may also have contributed to the disappearance of this anatomical feature. All bone modifications occur on the proximal end except for one mid-shaft cut mark that probably represents filleting. Kreutzer's (1992) volume density measurements are positively correlated with the portion frequencies ($r=0.80$), but even this relatively high correlation is not statistically significant since only five ranks are involved.

Metacarpal. Only 12 layers and interlayers contain the 24 metacarpal fragments, and their

Table 5.13. Portions of the bison metacarpal, proximal to distal.

Portions:[a]	C3F	C4F	AS	PS	AF	PF	MC	LC
Layers (NISP)								
IV-V (1)	-	-	-	-	1	1	1	1
VI (3)	1	2	3	2	2	1	1	1
VII (2)	2	1	2	1	-	-	-	-
VIII (2)	-	-	1	1	2	2	-	-
X (6)	1	2	2	3	-	-	-	-
XII (1)	-	-	-	-	1	-	-	-
XII/XIII (1)	1	1	1	1	1	1	1	1
XIV (3)	2	2	3	2	-	-	-	-
XIV/XV (1)	-	-	-	-	1	1	1	1
XVII (1)	-	-	-	-	1	1	1	1
XIX (1)	-	-	1	-	-	-	-	-
XXI (2)	-	-	-	-	1	1	1	2
Total (24)								
MNE	7	8	12	9	10	8	6	7
MAU	3.5	4.0	6.0	4.5	5.0	4.0	3.0	3.5
%MAU[b]	24.1	27.6	41.4	31.0	34.5	27.6	20.7	24.1
Modifications								
Impact scars	-	-	5	3	3	1	-	-
Density (Kreutzer 1992)								
Volume density (VD)[b]	-	0.59	0.63	-	0.60	-	-	0.53
Scan site	-	MC1	MC2	-	MC4	-	-	MC6

a. C3F, carpal 2+3 facet; C4F, carpal 4 facet; AS, anterior shaft; PS, posterior shaft; AF, anterior distal foramen; PF, posterior distal foramen; MC, medial condyle; LC, lateral condyle. b. Rank-order correlation, %MAU vs. VD: $r=1.00$, $P<0.01$.

maximum frequency is in Layer X (NISP = 6). The fragments are scored for eight portions, from proximal to distal, the proximal end (carpal 2+3 and carpal 4 facets), anterior and posterior shaft surfaces toward the proximal end, anterior and posterior foramen near the distal end, and medial and lateral condyles that comprise the distal end (Table 5.13). Impact scars are found at many locations along the shafts. It is interesting that the metacarpals apparently did not attract the attention of carnivores, yet the portion frequencies are perfectly correlated with volume density ($r = 1.00$).

Innominate. Only 27 innominate fragments are scattered through nine layers with a maximum frequency in Layer X (NISP=8). Such scarcity is consistent with the near-absence of the sacrum. We scored innominates in terms of eight portions, anterior to posterior: ilium blade, ilium shaft, ilioischial posterior border (marked by prominent muscle attachments), acetabulum, ischial and pubic shafts, ischial tuberosity, and pubic symphysis (Table 5.14). Impact scars on the ilium shaft and ilioischial border reflect a butchering technique whereby the innominate is broken free from the sacrum in order to detach the hind limb (e.g. Frison, et al. 1976: Fig. 17, no. 10). Much of the ilium blade remains

Table 5.14. Portions of the bison innominate, anterior to posterior.

Portions:[a]	ILb	ILs	IIb	ACE	ISs	ISt	PUs	PSY
Layers (NISP)								
II (1)	-	-	-	1	-	-	1	-
VI (1)	-	-	-	1	1	-	1	-
VIII+IX (1)	-	-	-	-	1	-	-	-
IX (1)	-	1	1	1	1	-	1	-
X (8)	3	3	1	1	1	-	1	-
XI (2)	1	1	1	2	1	-	2	-
XIII (1)	-	1	-	-	-	-	-	-
XIV (6)	-	3	3	1	-	-	-	-
XIX (6)	-	1	4	2	2	-	2	-
Total (27)								
MNE	4	10	10	9	7	0	8	0
MAU	2.0	5.0	5.0	4.5	3.5	0.0	4.0	0.0
%MAU[b]	13.8	34.5	34.5	31.0	24.1	0.0	27.6	0.0
Modifications								
Impact scars	-	3	3	-	-	-	-	-
Cut marks	-	-	-	-	1	-	-	-
Tooth marks	2	3	1	-	1	-	2	-
Density (Kreutzer 1992)								
Volume density (VD)[b]	0.22	0.52	0.53	-	0.50	0.19	0.55	0.39
Scan site	IL1	IL2	AC1	-	IS1	IS2	PU1	PU2

a. ILb, ilium blade; ILs, ilium shaft; IIb, ilio-ischial posterior border; ACE, acetabulum; ISs, ischium shaft; ISt, ischium tuberosity; PUs, pubis shaft; PSY, pubic symphysis. b. Rank-order correlation, %MAU vs. VD: $r=0.82$, $P<0.05$, $P>0.01$.

attached to the sacrum and is not retrieved. Another method that may often have been practiced at Sjovold is to break through the femoral neck, leaving the entire innominate in the field. Other details might be discerned if the bones were better preserved, but the thinly protected blood-rich cancellous tissue of the innominate is very attractive to carnivores that left tooth marks at many locations and may have obscured both impact scars and cut marks. The resulting portion frequencies are significantly correlated with volume density ($r=0.82$; $P<0.05$; $P>0.01$).

Femur. There is one complete femur, in Layer XI, and 46 femoral fragments are scattered among 15 layers and interlayers with maximum counts in Layers XI (NISP=10) and XIX (NISP=11). From proximal to distal we recognize the following portions: head, greater and lesser trochanters, anterior shaft (smoothly convex, featureless surface), linea aspera, postero-medial foramen, supracondyloid fossa, and proximal trochlear surface, medial and lateral condyles that form the distal end (Table 5.15). Impact scars occur at many locations along the shafts, but they are mainly concentrated on the anterior and posterior mid-shaft areas. Tooth marks are confined to the ends of

Table 5.15. Portions of the bison femur, proximal to distal.

Portions:[a]	H	GT	LT	AS	LA	PMF	SF	PT	MC	LC
Layers (NISP)										
II (1)	1	1	1	1	-	-	-	-	-	-
VI/VII (1)	-	-	-	1	1	1	1	-	-	-
VII (1)	-	-	1	1	1	1	1	-	-	-
VIII+IX (1)	-	-	-	-	-	-	-	-	-	1
X (6)	-	-	-	2	3	-	2	-	-	-
XI (10)	3	2	2	6	4	4	4	1	1	1
XII (1)	-	-	1	-	-	-	-	-	-	-
XII/XIII (1)	-	-	-	-	-	-	-	-	-	1
XIII (3)	-	-	-	-	1	1	2	-	-	1
XIV (5)	-	-	-	1	4	1	2	-	1	-
XIV/XV (1)	-	-	-	-	1	1	1	-	-	-
XV (2)	-	-	1	-	1	-	-	-	-	-
XVI (1)	-	-	-	-	-	1	1	-	-	-
XIX (11)	-	-	1	3	4	3	4	-	-	-
XXI (2)	-	-	-	-	1	1	2	1	1	1
Total (47)										
MNE	4	3	7	15	21	14	20	2	3	5
MAU	2.0	1.5	3.5	7.5	10.5	7.0	10.0	1.0	1.5	2.5
%MAU[b]	13.8	10.3	24.1	51.7	72.4	48.3	69.0	6.9	10.3	17.2
Modifications										
Impact scars	-	-	2	11	8	3	5	-	-	-
Cut marks	-	-	-	-	-	-	1	-	-	-
Charred	-	-	1	1	-	-	-	-	-	-
Tooth marks[c]	^{1J}3	3	^{J}1	-	-	-	-	1	1	^{3J}4
Density (Kreutzer 1992)										
Volume density (VD)[b]	0.31	0.22	0.34	-	0.45	-	0.36	-	-	0.26
Scan site	FE1	FE7	FE3	-	FE4	-	FE5	-	-	FE6

a. H, head; GT, greater trochanter; LT, lesser trochanter; AS, anterior shaft; LA, linea aspera; PMF, posterior-medial foramen; SF, supracondyloid fossa; PT, proximal trochlea; MC, medial condyle; LC, lateral condyle. b. Rank-order correlation, %MAU vs. VD: $r=0.94$, $P<0.05$; $P=0.01$. c. J, Juvenile specimen.

the bone, penetrating to the lesser trochanter only in a juvenile specimen. The only cut mark is similar to filleting marks described elsewhere (Binford 1981: Table 4.04, Fd-4). Scarcity of the head and greater trochanter is consistent with some of the butchering methods mentioned above in the discussion of the innominate, but carnivores may also have significantly reduced the frequencies of these portions as they have left evidence of the gnawing on nearly all remaining examples. Likewise the distal condyles and the trochlear surface offer easy access to blood-rich cancellous tissue, and most of the surviving specimens exhibit tooth marks. As a result, femoral portion frequencies are significantly correlated with volume density ($r=0.94$; $P<0.05$; $P=0.01$).

Table 5.16. Portions of the bison tibia, proximal to distal.

Portions:^{a}	TT	MC	LC	AC	PLF	PPS	DPS	DAS	MG	LG	FF
Layers (NISP)											
I (2)	-	-	-	-	-	1	-	-	1	1	1
VI (4)	1	-	-	-	1	1	2	2	-	-	-
VII (3)	-	-	-	1	-	-	2	2	2	2	1
VIII+IX (2)	-	-	-	1	1	1	-	-	-	-	-
IX (1)	1	1	1	1	-	-	-	-	-	-	-
X (13)	1	-	-	3	5	4	3	2	3	2	2
XI (15)	1	1	1	2	6	6	6	6	4	4	3
XII (6)	-	-	-	4	-	1	2	5	1	2	2
XIII (7)	-	-	-	1	2	4	-	1	-	-	-
XIV (5)	-	-	-	2	-	-	4	4	3	3	3
XVI (1)	-	-	-	-	-	-	1	-	-	-	-
XVI/XVII (3)	-	-	-	1	-	1	1	1	-	-	-
XIX (9)	-	-	1	1	2	1	1	3	2	3	2
XX/XXI (1)	-	-	-	-	-	-	1	1	-	-	-
XXI (7)	-	-	1	1	1	1	2	2	2	2	2
Total (79)											
MNE	4	2	4	18	18	21	25	29	18	19	16
MAU	2.0	1.0	2.0	9.0	9.0	10.5	12.5	14.5	9.0	9.5	8.0
%MAU^b	13.8	6.9	13.8	62.1	62.1	72.4	86.2	100.0	62.1	65.5	55.2
Modifications											
Impact scars	-	-	-	11	3	10	16	14	-	-	-
Cut marks	-	-	-	1	1	-	-	2	-	-	-
Charred	-	-	-	-	-	1	-	-	-	-	-
Tooth marks^c	1	-	3	-	-	-	^{R}1	1	-	1	-
Density (Kreutzer 1992)											
Volume density (VD)^b	-	-	0.41	-	0.58	0.76	-	0.44	-	0.41	-
Scan site	-	-	TI1	-	TI2	TI3	-	TI4	-	TI5	-

a. TT, tibial tuberosity; MC, medial condyle; LC, lateral condyle; AC, anterior crest; PLF, postero-lateral foramen; PPS, proximal-posterior shaft; DPS, distal-posterior shaft; DAS, distal-anterior shaft; MG, medial groove; LG, lateral groove; FF, fibular facet. b. Rank-order correlation, %MAU vs VD: r=0.41, P>0.05. c. R, Rodent-gnawed.

Table 5.17. Portions of the bison metatarsal, proximal to distal.

Portions:[a]	TCF	T2F	AS	PS	AF	PF	MC	LC
Layers (NISP)								
I (1)	1	1	1	1	-	-	-	-
III (3)	1	-	-	1	2	1	2	2
X (10)	3	3	3	4	1	1	3	3
XI (7)	1	1	4	1	3	3	3	3
XII (1)	-	-	-	-	-	-	1	1
XIV (2)	1	1	1	-	1	1	1	1
XVI/XVII (1)	-	-	-	1	-	-	-	-
XIX (1)	1	1	1	1	-	-	-	-
XXI (3)	-	-	-	-	2	2	2	3
Total (29)								
MNE	8	7	10	9	9	8	12	12
MAU	4.0	3.5	5.0	4.5	4.5	4.0	6.0	6.0
%MAU[b]	27.6	24.1	34.5	31.0	31.0	27.6	41.4	41.4
Modifications								
Impact scars	-	-	6	5	2	1	-	-
Cut marks	-	-	-	1	-	-	-	-
Tooth marks[c]	-	-	$^{J}1$	$^{J}1$	-	-	-	-
Density (Kreutzer 1992)								
Volume density (VD)[b]	0.52	-	0.59	-	0.51	-	0.48	-
Scan site	MR1	-	MR2	-	MR4	-	MR6	-

a. TCF, tarsal C+4 facet; T2F, tarsal 2+3 facet; AS, anterior shaft; PS, posterior shaft; AF, anterior distal foramen; PF, posterior distal foramen; MC, medial condyle; LC, lateral condyle. b. Rank-order correlation, %MAU vs. VD: $r = -0.40$, $P>0.05$. c. J, Juvenile specimen.

Tibia. This is the most abundant long bone (NISP=79), but it occurs in less than half (N=15) of the layers and interlayers with maximum concentrations in Layers X (NISP=13) and XI (NISP=15). A complete tibia was found in Layer XI. Named portions, proximal to distal, are proximal end (tibial tuberosity, lateral and medial condyles), anterior crest, postero-lateral foramen, proximal-posterior shaft, distal-posterior shaft, distal anterior shaft, and distal end consisting of lateral and medial grooves and the fibular facet (Table 5.16). The shaft areas are characterized by distinctive muscle attachments. Impact scars appear on all aspects and both ends of the shaft. All of the cut marks appear to be related to filleting (e.g., Binford 1981: Table 4.04, Tp-3, Td-4). Carnivore gnawing is rare at the distal end but is prominent among surviving proximal ends and may help to explain the scarcity of proximal surfaces. Despite this influence, portion frequency is not significantly correlated with volume density ($r=0.41$; $P>0.05$).

Metatarsal. Only nine layers contain the 29 metatarsal fragments, and Layer X (NISP=11) contains the highest number. The proximal end is comprised of the tarsal C+4 and tarsal 2+3 facets,

Table 5.18. Bison elements, volume density, and density scan sites (Kreutzer 1992).[a]

Element	MNE	MAU	%MAU	Volume Density	Scan Site
Mandible	17	8.5	58.6	0.53	DN1
Atlas	3	3.0	20.7	0.91	AT2
Axis	1	1.0	6.9	0.65	AX1
Cervical	10	2.0	13.8	0.37	CE1
Thoracic	15	1.1	7.4	0.38	TH2
Lumbar	11	2.2	15.1	0.39	LU3
Sacrum	1	1.0	6.9	0.27	SC1
Rib	97	3.5	23.9	0.57	RI3
Scapula	21	10.5	72.4	0.48	SP2
Humerus	21	10.5	72.4	0.48	HU4
Radius	19	9.5	65.5	0.56	RA2
Ulna	18	9.0	62.1	0.62	RA3
Radial carpal	5	2.5	17.2	0.42	Scaphoid
Intermediate carpal	9	4.5	31.0	0.35	Lunar
Ulnar carpal	8	4.0	27.6	0.43	Cuneif
Carpal 2+3	8	4.0	27.6	0.52	Trapmag
Carpal 4	10	5.0	34.5	0.44	Uncif
Metacarpal	13	6.5	44.8	0.63	MC2
Innominate	10	5.0	34.5	0.53	AC1
Femur	21	10.5	72.4	0.45	FE4
Tibia	29	14.5	100.0	0.44	TI4
Lateral malleolus	13	6.5	44.8	0.56	Latmal
Talus	8	4.0	27.6	0.72	AS1
Calcaneus	11	5.5	37.9	0.80	CA2
Tarsal C+4	11	5.5	37.9	0.77	NC3
Tarsal 2+3	10	5.0	34.5	0.50	2&3CP
Metatarsal	12	6.0	41.4	0.48	MR6
1st phalanx	28	3.5	24.1	0.48	P11
2nd phalanx	15	1.9	13.0	0.41	P21
3rd phalanx	12	1.5	10.3	0.32	P31

a. Rank-order correlation, %MAU vs. VD: $r=0.35$; $P<0.05$; $P>0.01$.

and other named portions are exactly like those on the metacarpal (Table 5.17). The patterns of bone modification are very similar on both "cannon bones," with impact scars all along the shaft but mainly toward the proximal end, and with tooth marks absent except on one foreshortened juvenile shaft cylinder. The only cut mark is oriented perpendicular to the long axis of the shaft and represents partial "ringing" of the metatarsal attributed to skinning (Guilday, et al. 1962:73). Unlike the metacarpal, metatarsal portion frequencies are negatively correlated with volume density ($r=-0.40$).

All Elements. Only the metacarpal, innominate and femur frequencies are significantly correlated with volume density when considered individually, and there is also a weak but significant correlation when all elements measured for density are considered as a group (Table 5.18). For the purpose of this correlation the maximum MNE for each element is ranked against the volume density reported for the corresponding or nearest scan site (Kreutzer 1992: Fig. 2). The correlation coefficient is rather low ($r=0.35$), but it is significant ($P<0.05$; $P>0.01$) because of the large number of comparisons ($N=30$). Using the same data, we find no statistically significant correlation within the axial skeleton ($r=0.41$) or the forelimb ($r=0.49$). However, there is a nearly significant negative correlation within the hindlimb ($r= -0.57$) where less dense elements tend to be more abundant. Therefore, with the exceptions noted above, we infer that bison element frequencies in the Sjovold site are not strongly conditioned by their volume density. Except where we find evidence to the contrary, we take this finding to mean that patterns of anatomical representation, element fragmentation, and bone modification may be interpreted as having cultural or behavioural significance in the layer-by-layer analyses.

Bison Age and Gender

Standard measurements (e.g., Duerst 1930; von den Driesch 1976; Speth 1983; Todd 1987a) not only aid many of the faunal identifications but also provide a basis for age and gender analysis of the bison remains (Appendix B). Age groups are defined on the basis of tooth eruption and wear patterns described by other researchers (Frison 1982; Frison and Reher 1970; Reher and Frison 1980; Frison, et al. 1976, 1978; Reher 1970, 1973; Todd and Hofman 1987; Wilson 1980, 1988). Wilson's (1980) analysis of bison dentitions from the Garnsey site is particularly important, because it is one of the few that deals with both maxillary and mandibular teeth. In fact, age groups in this analysis are given numbers (3-12) based on their similarity to age groups recognized at Garnsey for which Wilson (1980) provides detailed descriptions. In addition to the numbered age groups, we recognize three categories of eruption and wear that represent bison younger than any found at the Garnsey site. These three groups are briefly described below.

Age Group A: one maxillary specimen less than a year old at death and most similar to the 0.6 year-olds at the Casper site (M.C. Wilson 1974:153). The dP^4 is still strongly cusped; the entostyle is not yet in wear but is near the occlusal surface, and the enamel base is still below the level of the alveolus. Given a spring calving season, this animal, from Layer XIV, probably died in late autumn.

Age Group B: four maxillary and four mandibular specimens. The best two examples are maxillary tooth rows representing long-yearlings (1.0-1.5 year-olds) that probably died in spring or summer (Layers VIII-X, Test Profile No.3 [layer unknown]). Two M^2s tentatively assigned to this group are large enough to have erupted but are not yet worn (Layers XI, XIV). The four mandibular specimens are partial molar rows than cannot be precisely aged. A mandible from Layer X contains a partially worn M_2 (Stage 2; see Reher and Frison 1980) with M_3 still unerupted. In the other three specimens wear on M_2 has progressed to Stage 3. For two specimens (Layers XIII, XIV) a strict reading of the eruption and wear schedule developed for the Vore site (Reher and Frison 1980: Fig.

Table 5.19. Bison age groups based on tooth eruption and wear.

Layer	Maxillary	Mandibular
Layer II	-	8
Layer III	7	4?
Layer VI	C, 6	-
Mixed Layer VIII-X	B	4?
Layer IX	-	5
Layer X	C, 6	B, C, 10
Layer XI	B?	6, 8
Layer XII	4-5, 6, 10-11	5?
Interlayer XII/XIII	3-4, 10-11	6-7
Layer XIII	3-4	B, 4?, 5
Layer XIV	A, B?, 4-6, 7	B, 6?
Interlayer XVI/XVII	-	10-11
Layer XIX	C?, 4?, 5?	10-11
Layer XXI	-	B
Profile 2[a]	3-4	-
Profile 3[a]	B, 4-5	12

a. Profiles 2 and 3 yielded specimens than cannot be correlated with site stratigraphy.

40) suggests autumn season kills, consistent with the implication of the Group A maxilla from Layer XIV.

Age Group C: four maxillary and two mandibular specimens. A right maxilla containing dP^3-M^2 and P$^{2-4}$ is nearly identical to a left maxilla containing dP^3-M^1 and P$^{2-4}$, and they undoubtedly represent the same Layer X bison which is also represented by a right mandibular tooth row (dP$_4$ and P$_2$-M$_3$). The second premolars are strongly peaked and very slightly worn, suggesting that this bison was older than those of Garnsey Group 3 (2.0 yr) but younger than Casper Group IV (2.6 yr). Therefore it represents a spring or summer kill. The dP^{4}s are much more heavily worn than in Group B, and the dP^{3}s are worn through the prefossettes with the preselenes beginning to cup. The M^1 entostyles and M$_1$ exostylids are polished on the tip, and facet wear has reached Stage 8 on M^1 and Stage 6 or 7 on M^2 and M$_2$.

The older age groups are numbered in relation to groups described by Wilson (1980) for the Garnsey site, and only a few of them require discussion. Several Sjovold specimens are intermediate in wear between age groups defined at Garnsey, and a few are only tentatively assigned to age groups because of incomplete data resulting from post-mortem damage to the teeth. Left and right maxillae, each containing M$^{2-3}$, from Layer XIV, do not match the descriptions of Garnsey age groups, and they probably represent a single bison. These two maxillae would be assigned to an age younger than group 4 on the basis of M^2 but to an age of group 5 or older on the basis of M^3. If it is correct that both maxillae represent a single bison, the spalled enamel and asymmetric wear may be indicative of

Table 5.20. Methods and assignments to age and gender for bison bones.[1]

			Age and/or Gender					
Skeletal Element	Method	MNE	I	F/I	AF	AM	U	%AGA
Mandible	ABC	17	-	-	3	2	12	29.4
Atlas	D	3	-	2	-	-	1	66.7
Scapula, glenoid	DE	11	1	4	-	2	4	63.6
Humerus, proximal	F	2	-	-	-	-	2	0.0
Humerus, distal	FG	14	-	8	-	3	3	78.6
Radius, proximal	EFG	19	1	12	-	3	3	84.2
Radius, distal	EFG	10	4	-	2	3	1	90.0
Radial carpal	D	5	-	2	-	2	1	80.0
Intermediate carpal	D	9	-	3	-	5	1	88.9
Ulnar carpal	D	8	-	5	-	3	-	100.0
Carpal 2+3	D	8	-	6	-	2	-	100.0
Carpal 4	D	10	-	7	-	3	-	100.0
Metacarpal, proximal	EF	8	-	3	-	2	3	62.5
Metacarpal, distal	EF	7	-	-	2	5	-	100.0
1st phalanx, manus	FG	11	-	4	-	6	1	90.9
Femur, proximal	EF	4	1	-	1	2	-	100.0
Femur, distal	EF	5	2	-	1	1	1	80.0
Tibia, proximal	EFG	4	-	-	2	-	2	50.0
Tibia, distal	EF	19	3	7	-	5	4	78.9
Lateral malleolus	D	13	-	8	-	4	1	92.3
Talus	D	8	-	4	-	4	-	100.0
Calcaneus	DE	11	2	1	3	5	-	100.0
Tarsal C+4	D	11	-	5	-	6	-	100.0
Tarsal 2+3	D	10	-	5	-	4	1	90.0
Metatarsal, proximal	F	8	-	2	-	2	4	50.0
Metatarsal, distal	EF	12	2	-	8	1	1	91.7
1st phalanx, pes	D	22	-	3	-	13	6	72.7

1. Method: A, molar row length (Todd and Hofman 1987); B, height at M3 (Reher 1974); C, distal M3 to articular condyle (Shackleton, et al. 1975); D, bivariate plots (Speth and Parry, 1980; Morlan 1991); E, epiphyseal fusion; F, discriminant function analysis (Roberts 1982; Walde 1985, 1994; Brink, et al. 1986); G, descriptive statistics based on other methods. MNE, minimum number of elements; I, immature; F/I, female or immature; AF, adult female; AM, adult male; U, unassigned to age or gender; %AGA, percent assigned to age and/or gender.

malocclusion resulting from a pathological condition. Assignments of mandibles to age groups 4 and 6 are tentative because of incomplete data at Garnsey, and other Sjovold specimens are intermediate in wear between groups defined at Garnsey. The distribution of age groups is shown in Table 5.19.

Most previous studies of bison age based on tooth eruption and wear have concerned seasonally restricted kill sites (e.g., Agate Basin, Garnsey, Glenrock, Hawken, Horner, Vore, and Wardell) where the distribution of tooth height forms a stepped pattern believed to mark age groups separated by annual increments of wear. The Sjovold teeth were recovered from a habitation site where different components may have been occupied in different seasons. Therefore, regular yearly spacing between age groups cannot be demonstrated. Furthermore, it is possible that the northern Plains and parkland habitat of the Sjovold bison conferred a different, probably slower, wear rate than that experienced by bison represented in kill sites farther south. Wilson (1980:99) found an average attrition rate of 6.00 mm/year for the Garnsey site, in New Mexico, but the Late Prehistoric Glenrock and Wardell sites, in Wyoming, yielded rates of only 3.2 and 3.3 mm/year, respectively (Reher 1970, 1973). Haynes (1984) calculated a rate of only 1.7 mm/year for Wood Buffalo Park. Hence the age groups are useful for arranging Sjovold dentitions in a relative series, but the older groups might be separated by more than a year if the wear rate was relatively slow.

The regional rate of tooth wear can only be determined by analysis of a seasonally restricted kill site in south-central Saskatchewan, and no such site has yet been analyzed in this respect. The nearest candidates are Ayers-Frazier (Clark and Wilson 1981) and Henry Smith (Wilson 1988) in Montana, and Melhagen (Ramsay 1991) and Harder (Morlan 1994c) in Saskatchewan. Ayers-Frazier yielded a very small sample, and the Henry Smith site sample is characterized by numerous genetic anomalies and pathological conditions associated with an apparently rapid rate of wear that may be inappropriate for understanding the Sjovold bison. Ramsay (1991) conducted an age analysis of Melhagen bison teeth but neither calculated a rate of wear nor provided data that permit us to do so. Harder is a seasonally restricted campsite with an average wear rate of 5.8 mm/year for the mandibular molars, but its bison had access to a more xeric grassland than has since existed in the region (Morlan 1994c). A more xeric grassland may imply more grit in the diet and a faster rate of wear (Wilson 1988) than would be relevant to the Sjovold site.

Various post-cranial elements also furnish evidence of bison age, but they rest on the assumption that North American bison follow a schedule of epiphyseal fusion similar to that of the better studied European wisent (*Bison bonasus*; Koch 1935; Empel and Roskosz 1963). In this study we employ the data of Empel and Roskosz (1963; see Todd 1987b:172; see Appendix 2).

Bison exhibit sufficient sexual dimorphism that gender can be inferred from measurements of bones that can be shown to have reached adulthood (e.g., Bedord 1974, 1978; Peterson and Hughes 1980; Reher 1974; Shackleton, et al. 1975; Speth and Parry 1980; Speth 1983; Todd 1987a, 1987b; Todd and Hofman 1987). Most of the cited studies concern mandibles or the major limb elements in which tooth eruption or epiphyseal fusion demonstrates adult age, but bones lacking obvious epiphyses also exhibit pronounced bimodality. The latter include the carpals and tarsals which can be sorted into two groups: adult bulls, and a mixed group of calves and adult cows (Morlan 1991). Methods for determining the gender of phalanges have also been proposed (Duffield 1973; Roberts 1982).

Collectively, these studies present a powerful set of tools for inferring the sex composition of a bison bone sample (Table 5.20), but many of the methods are weakened by reliance on whole bones, the use of ratios, and the assumption that bimodality always represents sexual dimorphism. The methods can be improved through statistical analysis of measurements on bison of known age and sex.

Table 5.21. Minimum number of bison animal units by layer and age/gender.

Layer	NISP	MAU[a]	Calf	Cow or Calf	Cow	Bull
I	15	0.5	0.5	-	-	-
I/II	0	-	-	-	-	-
II	6	0.5	-	-	0.5	0.5
II/III	0	-	-	-	-	-
III	37	2.0	1.5	-	1.0	0.25
III/IV	0	-	-	-	-	-
IV-V	6	0.5	-	-	-	0.5
V/VI	0	-	-	-	-	-
VI	40	1.5	0.5	0.5	-	0.5
VI/VII	2	0.5	0.5	0.5	-	-
VII	36	1.0	0.5	0.5	-	0.5
VII/VIII	2	0.5	-	0.5	-	-
VIII	8	1.0	1.0	-	-	0.5
VIII/IX	4	0.5	0.5	-	-	-
VIII+IX	27	1.0	0.5	-	-	0.5
IX	9	0.5	-	-	0.5	-
X	186	3.0	1.5	-	1.0	1.5
XI	117	3.0	1.0	-	1.0	1.0
XII	46	1.5	-	1.0	-	0.5
XII/XIII	19	1.0	0.5	1.0	-	0.5
XIII	42	1.5	1.0	0.5	-	0.5
XIII/XIV	1	0.5	-	-	-	-
XIV	112	3.5	1.0	1.5	-	1.0
XIV/XV	16	1.0	-	0.5	-	0.5
XV	8	1.0	-	-	-	-
XVI	15	1.0	-	-	0.5	0.5
XVI/XVII	14	1.5	0.5	-	0.5	-
XVII	7	1.0	-	0.5	-	0.5
XVIII	2	0.5	0.5	-	-	-
XIX	107	2.5	0.5	2.0	-	0.5
XX	0	-	-	-	-	-
XX/XXI	3	0.5	-	-	-	-
XXI	53	1.5	1.0	-	1.0	0.5

a. MAU ignoring age and gender, not a sum of the columns to the right.

For example, Roberts (1982) uses discriminant function analysis to derive a single equation that defines the boundary between males and females for measurements of the front first phalanges. Walde (1985) uses Speth's (1983) data to generate pairs of discriminant functions for male and female proximal and distal ends of the major limb elements (humerus, radius, femur, tibia, and both main metapodials). Discriminant function equations for the distal humerus and distal tibia have been derived independently by Brink, et al. (1986:194). Comparable analysis of carpal and tarsal elements has not yet been performed.

The age and gender analysis is a crucial step toward the objectives of the layer-by-layer analysis (Table 5.21). These objectives include an understanding of the subsistence economy reflected in each layer. Since Sjovold appears to have functioned as a camp site at a distance from kill site and primary processing areas, we are somewhat blind to certain aspects of subsistence such as methods of bison procurement (jumps, pounds, solitary hunting, etc.). However, the age and gender composition of the bones brought to the camp retain some reflection of the target population (nursery herds, bull groups, solitary bison). These issues may vary seasonally as well as in response to circumstantial factors surrounding the purpose of any given Sjovold occupation (number, gender and age of the people, their distance from home). The layer-by-layer analyses consider these matters in some detail, but in general we suspect that small group or solitary hunting, perhaps along the edges of the brushy coulee, was a common bison procurement technique at Sjovold. However, the relative abundance of cows and calves in the larger assemblages (Layers X, XI, XIV, and XIX) hints that significant communal hunts of nursery herds were occasionally practiced in the area.

Chapter 6

The Youngest Layers

The principal focus of this chapter is a late prehistoric occupation designated Layer I, but we also present a small assemblage of recent historic material found in the sod layer as well as a few prehistoric materials found in an interlayer between Layers I and II.

The Sod (Recent Historic)

The Sjovold site is capped with sod composed of a 3-7 cm thick Ah horizon of sandy soil bound together by prairie grass. The development of sod indicates that the present surface has been stable for decades if not longer. The high point in our excavation area was the surface at 2n2w. From that point the ground sloped downward to the east (11:200), west (21:400), and south (23:335) with the only upslope being to the north (12:200). There were two small features, but no artifacts, on the surface of our excavations. However, we noted a few pieces of wood charcoal and heat-distorted glass lying immediately to the north which indicated that there had been a hearth nearby in recent years. On adjoining surfaces we saw other evidence for recent activities: a hearth with broken bottles (beer and soda pop, 30 m N); two stone-ringed hearths with wiener sticks and broken glass (40 m NW and 150 m W); a section of dirt road which is part of a municipal road that was abandoned in 1962 (90 m NW); and a post-in-ground bench (135 m W), collapsed wooden observation towers (200 m NW and 240 m S), and small earth-filled pits (210 m SSW) which Sjovold family members told us were the remains of boy scout camps dating to the 1960s, 1970s and 1980s. We disposed of the top 2-3 cm from the excavation units without screening.

Features and Groundplan

The two features on the surface of the block excavation area consisted of a shallow rectangular pit and a low pile of earth adjoining to the east. Both had a sparse covering of weeds and tufts of grass. The pit was about 1.5 m north to south by 0.75 m west to east, had more or less vertical sides, and was situated largely within our XU 1 (unit 0n0w). As our excavations progressed we found that the pit had been excavated to a depth of 0.8 m below surface and had been backfilled approximately to the rim. The backfilled earth had settled about 10-15 cm leaving a shallow hollow at the surface. Within the backfill in the pit was a mixture of historic and prehistoric artifacts, some of which almost certainly were derived from both surface and subsurface layers. Ralph and Leslie Sjovold told us that this was the test pit they excavated during the mid 1960s.

Artifacts

There were 20 historic artifacts, all attributable to very recent times, in the backfill of the Sjovold brothers' test pit (Table 6.1). The majority (18) are pieces of bottle glass including eight brown sherds, probably from beer bottle(s), and ten clear sherds with partially stippled and embossed exterior surfaces, probably representing soft drink bottle(s). Most of the glass has been contorted by heat. The brown sherds are about 2.5 to 3.5 mm thick; the clear ones about 4-6 mm. One clear sherd is embossed with the words "(AUT)HORITY", "(C)OLA" and "LTD".

Table 6.1. Historic artifacts within 1960s test pit fill.

Excavation Level	Bottle Glass	Buttons	Cartridges	Total
01-1	7	-	1	8
01-2	-	1	-	1
03-1	8	-	-	8
04-2	3	-	-	3
Total	18	1	1	20

A rusty metal overall or brace button is made of two interlocked pieces. The front piece is flat, disk-shaped, and about 17 mm in diameter. Its face is impressed with a grid pattern of fine lines at intervals of about 0.5 mm. The face has a shallow central depression about 5.5 mm in diameter and 1 mm in depth. At the bottom of the depression are two semicircular holes separated by a shaft of metal which is about 2 mm in width. The shaft and semicircular holes have been formed by a punch which pierced the face folding two small flaps of metal directly under the shaft. The edges of the face piece have been crimped over top of the back piece firmly locking the two together. The back piece is slightly convex and has a single circular hole at the center which matches the semicircular holes and shaft of the front piece. The backside hole is reinforced by a bordering ridge about 1.5 mm in width and less than 1 mm in height. Buttons of this general type have been mass produced since the end of the nineteenth century (Luscomb 1967:224).

There is one brass cartridge casing. The cartridge, with the incised words "DOMINION SPRG 30.06" around the perimeter of the firing end, lacks a charge and has a small round pit in the center of the firing platform indicating discharge. The casing belongs to a 30.06 calibre rifle, an example of which Mr. Sjovold owns and recalls having discharged at the site within the past twenty years.

Interpretation of Historic Artifacts

These artifacts date to the twentieth century and probably all were derived from the surface of the site. While it seems likely that the modern surface and its underlying sod are more than just a few decades old, the Sjovold backfill contained neither early historic material nor materials that of protohistoric age (i.e. AD 1600-1750). The beer bottle and pop bottle glass are consistent with picnicking and camping activities known to have been frequent occurrences in this locality since about 1910. The shell casing is indicative of target practice or hunting and is probably attributable to Mr. Oscar Sjovold. The creek mouth was also a fishing spot visited by Mr. Sjovold, and he may also have been the source of the overall button.

Layer I (Late Prehistoric)

The first buried occupation layer was situated between the bottom of an AC soil horizon and top of a C1 soil horizon some 17 cm below surface at 2n2w. Its contours were parallel to those of the modern surface. Layer I contained neither features nor a clear occupation floor, and the bulk of its artifacts — a few stone tools, a chipped stone core, a few potsherds, a bit of chipping debitage, a few pieces of coarse rock and a couple of handfuls of broken bone — were scattered through a vertical distance of about 3-6 cm. We also recovered a handful of aboriginal potsherds, chipped stone debitage, coarse rock, and bone fragments from backfill in the Sjovold brothers' test pit. These materials are comparable to *in situ* specimens from buried occupation layers I-IV. We saved these pieces, but because of their disturbed context we have not included them in this analysis. A radiocarbon date on bone from Layer I indicates that occupation occurred between AD 1250-1450 (cal 700-500 BP).

Features and Groundplan

There were no features, other than the Sjovold test pit, in our exposure of Layer I. In searching for the location of the layer we passed through it without making a planview of the sparse scatter of artifacts it contained.

Rock

The coarse rock sample (n=38) from XUs 1-6 includes all pieces of stone which are neither tools nor chipping debris (Table 6.2). The bulk of the small Layer I sample is granite which is readily available as cobbles and pebbles on nearby valley walls and river flats (Dyck 1990). It is a stone type which was well suited to most aboriginal purposes involving firing (e.g., Blackwelder 1927; Toom and Baumann 1983). As it turns out, the Layer I granite pieces do have the characteristics of fired or fire-broken rock — an advanced degree of "weathering", shattering into chunks and a somewhat orange/red hue. Thus, it seems likely that there was a hearth nearby, possibly at the brink of the creek bank near XU 5. The tiny remainder of coarse rock in Layer I is a mixture of additional crumbs of fired rock and small unmodified pebbles. An exception is the single piece of basalt which may be a bit of chipping debris.

Table 6.2. Coarse rock from Layer I.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
basalt	-	-	-	1	-	-	1
chert	-	-	-	-	-	1	1
concretion	-	-	-	-	1	-	1
granite	-	-	-	1	2	5	8
quartz	1	2	1	-	-	1	5
shale	-	-	-	-	-	2	2
sandstone	-	-	-	-	1	-	1
silicified sediment	-	1	-	-	-	-	1
unidentified	-	-	1	2	4	11	18
Total	1	3	2	4	8	20	38
Weight							
basalt	-	-	-	4	-	-	4
chert	-	-	-	-	-	4	4
concretion	-	-	-	-	2	-	2
granite	-	-	-	1	1,349	547	1,897
quartz	1	9	3	-	-	1	14
shale	-	-	-	-	-	1	1
sandstone	-	-	-	-	15	-	15
silicified sediment	-	4	-	-	-	-	4
unidentified	-	-	1	3	3	26	33
Total	1	13	4	8	1,369	579	1,974

Pottery

Four body sherds of aboriginal earthen ware were recovered from XUs 1 and 2, all less than 3 cm in greatest dimension and with a thickness of 6 mm. The sherds seem to belong to a single vessel (vessel A); two pieces can be refitted. Their exterior is buff to black, fabric-impressed, and has been smoothed almost to the point of obliterating the impressions. The core is carbonized and sparsely tempered with crushed granite ranging in size from 2-6 mm. The interior surfaces are smooth and buff/orange to black.

Stone Tools

Four stone tools were found in Layer I. A flat rectanguloid cobble with a rough cortex having the texture of medium-grained sandstone appears to have served as an abrader (Table 6.3). We have tentatively identified the rock as gneiss, but it may be banded sandstone. Calcium carbonate adheres to most of the ventral surface and to parts of the sides. Almost half of the same ventral surface, from the center to one edge, is polished smooth. Possible causes of this polish are use of the object for hide-

Table 6.3. Stone tools from Layer I.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole
abrader	398	1	702.2	105	80	41	gneiss	y
chipping hammer	1990	5	327.9	75	72	36	sandstone	y
endscraper	1971	6	1.3	19	17	5	chert	n
MURL	1972	6	5.1	27	21	7	petrified wood	n

Table 6.4. Chipped stone debris from Layer I.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
andesite	-	-	-	1	-	-	1
chert	-	-	-	-	3	-	3
Knife River Flint	-	1	-	-	1	-	2
petrified peat	-	-	-	1	-	-	1
petrified wood	2	2	-	1	-	1	6
Swan River Chert	1	1	-	-	1	1	4
silicified sediment	1	-	-	-	-	2	3
unidentified	-	-	1	1	1	-	3
Total	4	4	1	4	6	4	23
Weight							
andesite	-	-	-	1.3	-	-	1.3
chert	-	-	-	-	6.7	-	6.7
Knife River Flint	-	0.2	-	-	1.0	-	1.2
petrified peat	-	-	-	34.3	-	-	34.3
petrified wood	0.3	0.7	-	1.9	-	23.2	26.1
Swan River Chert	0.6	0.1	-	-	0.8	0.4	1.9
silicified sediment	1.2	-	-	-	-	1.7	2.9
unidentified	-	-	0.3	0.1	1.2	-	1.6
Total	2.1	1.0	0.3	37.6	9.7	25.3	76.0

graining or seed-grinding.

The endscraper, a triangular dorsally retouched flake scraper, is represented only by the haft end. It is made of red, brown and black chert and appears to have been snapped and then subjected to heat as evidenced by one pot-lid fracture scar.

The chipping hammer is a discoid pebble of buff-coloured sandstone with polished dorsal and ventral faces and with two crushed/pecked edge areas, one about 60x22 mm and the other, opposing, about 27x15 mm.

The MURL (marginally utilized or retouched lithic) is a segment of mainly unifacially chipped edge.

Chipped Stone Debris

Chipped stone debris includes eight small flakes, 14 small pieces of shatter and one bipolar core (Table 6.4). The core (catno 1997) is petrified wood. It weighs 23.2 g, measures 25-49 mm on its longest axis and was found in XU 6. All of the chipped stone debris is suspected to have been derived from secondary surface sources in the vicinity. Even with such a small sample it is evident that there is some correspondence between stone tools and chipping debris. Petrified wood/peat represents one of two chipped stone tools and is a major part of the chipped stone debris. It may be inferred that petrified wood/peat was brought to the site for tool manufacture, while rejuvenation of tools accounted for the other odds and ends of chipping debris. The chipping hammer probably was used to create this debris. By degree of use (measured by extent and depth of pecked areas) it seems likely that this tool chipped more stone than just the remains we recovered. Furthermore, the dispersal of debitage suggests either that chipping activities were scattered and of low intensity or that the excavation area was peripheral to a more intensively used activity area. The variety of stone types in the sample indicates that several tools other than those we recovered were repaired at the site.

Faunal Remains

Prior to analysis, some of the recovered bones supplied a radiocarbon sample (S-1757) for this layer. The sample weighed approximately 250 g and contained slightly more than a third of the large mammal bone recovered from Layer I. It included all unidentifiable bone from XUs 2 and 3 as well as a bison thoracic vertebra from XU 1. The remaining faunal material is shown in Table 6.5.

Bison, NISP=15: vertebral centrum, two intervertebral discs, posterior disc from lumbar 5, humerus shaft, ulnar carpal ♀/©, carpal 2+3 ♀/©, carpal 4 ♀/©, tibia shaft, tibia distal epiphysis ©, lateral malleolus ♀/©, proximal metatarsal ©, talus ♀/©, tarsal 2+3 ♀/©, tarsal 1. All of these elements could represent a single calf (MAU=0.5) less than three years old (age of distal tibia fusion). Of two fresh-fractured bones (Table 6.6) one is the humerus shaft exhibiting two impact scars suggesting marrow retrieval. The metatarsal has been gnawed by a carnivore.

Size 5-6 mammal, unidentified, n=25: one cranial, four tooth, six rib, one costal cartilage, three scapula blade, ten long bone shaft fragments. It is likely that all these fragments represent bison, but they cannot be positively identified. The cranial and tooth fragments indicate that portions of a bison(?) skull were introduced to Layer I. Fifteen (60%) of these specimens were fractured when fresh, and the predominance of long bone fragments may reflect marrow retrieval. One of the ribs bears a carnivore tooth puncture.

Dog, NISP=41: M^1 fragment, 9th thoracic vertebra, ten rib fragments, two sternum centra,

Table 6.5. Vertebrate remains from Layer I.

Size, Taxon	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
6, Bison	5	-	-	8	1	1	15
5-6, mammal	4	-	-	7	9	5	25
4, Dog	-	-	-	1	-	40	41
4, mammal	4	-	-	-	-	-	4
3, Rabbit or Hare	1	-	-	-	-	1	2
-, mammal	45	-	-	79	47	50	221
Total	59	0	0	95	57	97	308
Weight							
6, Bison	25.4	-	-	239.1	23.6	24.7	312.8
5-6, mammal	10.2	-	-	17.1	12.8	15.1	55.2
4, Dog	-	-	-	1.0	-	57.3	58.3
4, mammal	0.9	-	-	-	-	-	0.9
3, Rabbit or Hare	0.1	-	-	-	-	0.7	0.8
-, mammal	14.3	-	-	26.6	9.9	17.6	68.4
Total	50.9	0.0	0.0	283.8	46.3	115.4	496.4

Table 6.6. Modified vertebrate remains from Layer I.[a]

								Fracture States				
Size, Taxon	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	-	-	1	-	7	10	-	1	1	2	11	15
5-6, mammal	-	-	1	-	*	*	4	-	6	15	-	25
4, Dog	-	-	-	-	1	31	1	15	-	-	25	41
4, mammal	-	-	-	1	-	1	-	-	2	1	1	4
3, Rabbit or Hare	-	-	-	2	-	-	-	1	-	1	-	2
-, mammal	-	3	2	23	*	*	-	*	*	*	-	221

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

radius* lacking distal epiphysis, radial carpal, two ulnar carpals, distal carpals 1-4, two accessory carpals, metacarpals* I-IV (5 fragments), three 1st phalanges, five 2nd phalanges, four 3rd phalanges. Except for the molar fragment, all of the canid remains were recovered from XU 6, and all of them appear to represent a single skeleton. Elements marked with an asterisk (*) furnished measurements indicating that this canid is a dog. The metacarpals are almost identical in size and shape to those of our smaller reference dog (see Fig. 5.1), and they are larger than coyote metacarpals. The radius is already larger than that of coyotes without its distal epiphysis having fused. The radius had weathered to Stage 1 prior to burial. Most of the bones exhibit superficial to moderate rootlet etching, suggesting that they have had a burial history similar to that of the bison bones. However, none of the canid bones was fractured when fresh, and none exhibits butchering marks.

Size 4 mammal, unidentified, n=4: cranial fragment, thoracic intervertebral disk, costal cartilage, long bone shaft fragment. These bones may be from the dog but cannot be positively identified.

Rabbit or Hare, NISP=2: thoracic vertebra, proximal tibia with unfused epiphysis. Both bones are pitted and thinned by digestion.

Unidentified mammal, n=221: fragments less than 4 cm in length. Two exhibit carnivore tooth marks and 23 show evidence of digestion. Twelve of the latter bear fecal residue, indicating consumption by a carnivore. Two fragments are charred, and one is calcined.

Discussion: We suggest that people brought to the site part of a bison calf to use the meat and the marrow. The record of this event is somewhat obscured by losses to marrow processing, carnivore ravaging, and the radiocarbon laboratory. Whether the recovered dog was a scavenger on these remains or whether it also represents a food item cannot be determined. The leporid appears to have fed the dog, not the people.

Interpretation of Layer I

Our excavations in Layer I provided a peripheral view of the remains of aboriginal activities focused on the consumption of (most parts of) a single young bison. These late prehistoric activities included the boiling of meat, breaking of marrow bones, and scraping and softening of the skin. We presume that most of the coarse rock in the Sjovold site was collected from surface deposits nearby and carried to the site by aboriginal people for stone boiling, food roasting and other fire-associated activities. Supplementary activities included reduction of local chipping material (petrified peat and wood) to make edged tools. The MURL is a broken or aborted example of such manufacture, possibly for use in dismemberment of the bison or to replace cutting tools used up in disarticulation of the carcass. Chipping activities also included light rejuvenation of tools which were not discarded at the site, or at least were not found in our excavations. Remains of a dog were found at one side of the excavations but it has not been possible to determine what role the animal played in relation to human activities. Remains of another animal, a rabbit, are almost certainly stomach contents of a scavenger such as the dog. An earthen vessel was broken during the occupation, but only a small part of it was discovered in our excavations. Its presence reinforces the notion that camp/kitchen activity occurred nearby. Altogether, this assemblage is indicative of short-term, bison consumption and skin dressing activities, plus limited chipped stone tool manufacture and rejuvenation, all of which was marginal to a nearby hearth.

This is the kind of assemblage one would expect to find at the edge of single family's temporary campsite. One thinks of a family rather than of a lone male hunter or a small war party because of the presence of pottery and the indication of skin dressing. The archaeological identity is Late Prehistoric but cannot be specified more closely because of the lack of diagnostic materials. A radiocarbon age estimate places the occupation between AD 1250 and AD 1450 (cal 700-500 BP; see Table 3.6).

Interlayer I/II

Features: The only feature in the interlayer was the Sjovold brothers' test pit in XU 1.

Rock: Five pieces of unidentified coarse rock weighing 7 g were found in XUs 4 and 5.

Chipped Stone Debris: Six pieces of chipped stone weighing 10 g were found in XUs 4 and 5, including one chert, one Gronlid Siltstone, three petrified peat and one silicified sediment. Aside from the Gronlid Siltstone, which was probably associated with Layer II, most of the materials were probably from Layer I.

Faunal Remains: A small assemblage of bone fragments was recovered from XUs 4-6 in the interlayer.

Size 5-6 mammal, unidentified, n=16 (46.4 g): 12 rib, one scapula blade, three long bone shaft fragments. One rib bears a carnivore tooth puncture, and one long bone fragment exhibits a cut mark adjacent to a muscle attachment, probably a result of filleting.

Unidentified mammal, n=49 (12.3 g): fragments less than 4 cm in length. Three specimens exhibit pitting and thinning due to digestion.

The cut mark represents human activity, but the tooth mark and evidence of digestion probably reflect carnivore ravaging. These are the same activities found both in overlying Layer I and in underlying Layer II. Probably most of these specimens were trampled down from Layer I.

Chapter 7

Layer II: A Moose Jaw Summer Kitchen

Introduction and Planview

Layer II lies 33-38 cm below surface at 2N2W and is coincident with a faint buried soil horizon labelled Ahb1. We found the bulk of Layer II cultural remains within the 5 cm depth of the Ahb1 soil horizon, but we also found a substantial trace of similar materials, in diminishing quantities, in the interlayer below. Most interlayer artifacts were small. Rodent burrowing between Layers I and IV in the east half of XU 1 was probably responsible for the downward drift of occupation materials in that area, but the cause(s) for downward displacement in other areas has not been determined. A radiocarbon date on bone indicates that the Layer II occupation occurred between AD 1150-1350 (cal 800-600 BP; Table 3.6).

The Layer II planview (Fig. 7.1) reveals four aboriginal features as well as the test pit made by the Sjovold brothers. Piece-plotted artifacts include two MURLs and a bone pressure flaker fragment closely associated with the features. Faunal remains include a mandible, a humerus, a femur, and a thoracic vertebra, all identified as bison bones. Sherds of two pottery vessels occur in spatially discrete clusters.

Features

Feature F2-a (Table 7.1) was comprised of two adjoining parts; a thin patch of ashy soil about 1 m long and, adjoining to the north, a patch of slightly blackened soil about 0.5 m long. The ashy patch, apparently the heart of the feature, contained very sparse amounts of ash and flecks of charcoal, a couple of chipped stone flakes, several pieces of bone, some of them charred, one MURL and one bone tool. The blackened patch contained a faint shadow of blackened soil and a single bone fragment. Only a portion of the feature was exposed by excavations, and the remainder is still buried east of XU 1. There was no staining or oxidation beneath this feature and, consequently, its margins and profile were difficult to define. They simply graded into the buff soil matrix. Depth was in the range of 1-5 cm. Near the southwest border was a cluster of rocks and other debris comprising F2-b. This close association could be an indication that the two features were used together. The ash, flecks of charcoal, blackened soil and the close association of F2-b are the basis for our identification of F2-a as a surface hearth. The absence of subsoil burning or staining leads us to the inference that the fire was neither intense nor long-lived. Furthermore, the sparseness of charcoal and ash could be a result of erosion by wind, or of deliberate dispersal of hearth contents by the site occupants. The fact that

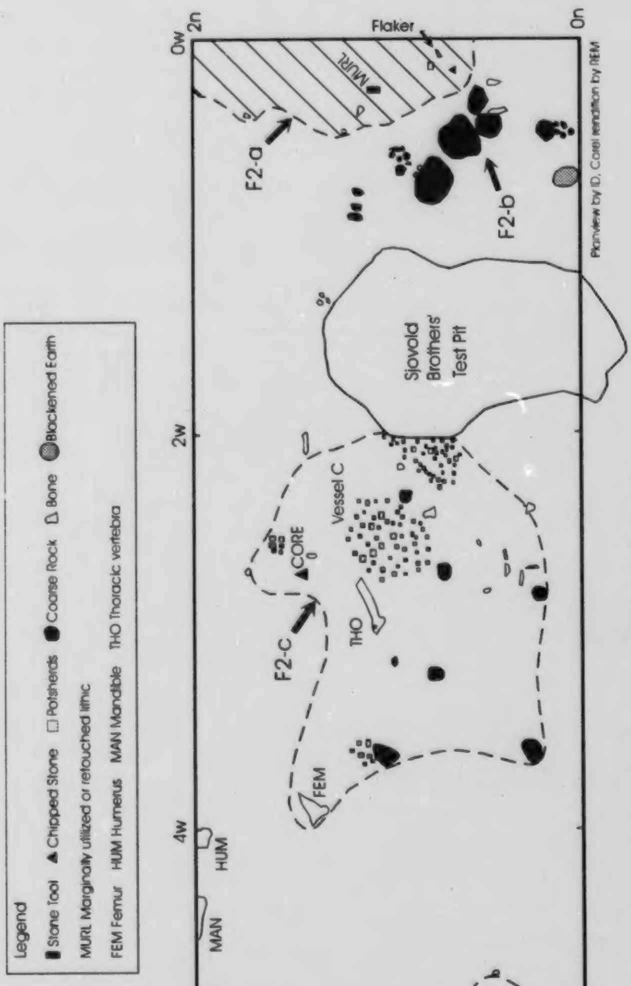

Legend
Stone Tool
Chipped Stone
Potsherds
Coarse Rock
Bone
Blackened Earth
MURL Marginally utilized or retouched lithic
FEM Femur
HUM Humerus
MAN Mandible
THO Thoracic vertebra
0w
2n
0n
2w
4w
6w
Flaker
MURL
F2-a
F2-b
Sjovold Brothers' Test Pit
Vessel C
CORE
F2-c
THO
FEM
HUM
MAN
MURL
F2-d
Vessel B
Planview by D. Corel rendition by REM

Figure 7.1. Planview of Sjovold Layer II.

charred and calcined bone fragments were found elsewhere in the exposure outside the limits of this feature is evidence for the operation of some sort of mechanism for dispersal of hearth contents, whether from F2-a or from unexposed hearths nearby.

Table 7.1. Features in Layer II.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F2-a	surface hearth	120n10w	>145	>50	1
F2-b	rock cluster	60n55w	120	50	<6
F2-c	artifact cluster	100n270w	150	>200	>2
F2-d	artifact cluster	100n530w	>190	110	>2

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

Feature F2-b was an elongate grouping of rock, chipped stone, and ceramic debris resting on buff-coloured soil (see Fig. 7.2). The northeast edge of F2-b was about 5-25 cm away from and roughly parallel to the southwest edge of F2-a. At the center of F2-b was a tight grouping of two large (>150 mm) flat cobbles and two medium-size (100-149 mm) rounded cobbles of coarse rock in an area measuring about 60 cm x 30 cm. All of these rocks looked as if they had been subject to extensive weathering, but they were still intact. Whether the appearance was due to natural exposure, to firing, to contact with hot items, or to being pounded upon cannot be determined from the photographs. It is evident that the two smaller rocks were arranged transversely to the line of the two larger ones and could have formed a triangular support for a vessel. To the north and south of this rock grouping and within it were several small to very small pieces of rock, mainly of fire-cracked granite. One medium piece of fire-cracked granite about 25 cm south of the main group appeared to be weathered to the point of breaking apart *in situ*. Nearby were several smaller pieces of fire-cracked rock, apparently the same material. It is puzzling that the majority of small pieces of fired rock in XU 1 lay within the bounds of F2-b, rather than in F2-a, the adjoining hearth. A possible inference is that the main disaggregation of the rock occurred during use and discard rather than during firing. Also among the rocks of this feature were a couple of tiny vessel C potsherds, a few bone fragments and a few chipped stone flakes. About 50 cm south-southwest of the central grouping was a patch or post mold (unfortunately our records fail to record which) of charcoal-rich soil (Fig. 7.1, blackened earth). The patch was 12 cm in diameter. Overall length of F2-b was about 130 cm, the greatest width about 40 cm. There was a notable void in artifacts to the west and southwest, measuring at least 1 m by 0.5 m. It extended to and possibly through the Sjovold test pit.

Our preferred interpretation is that F2-b functioned as a fireside work station. The larger rock at the north end could have served as a anvil and work surface. It had the greatest amount of broken bone and chipped stone around it. Bones could have been roasted on the fire and then broken on the rocks to remove the marrow. Repair of chipped stone tools could have been performed at the same

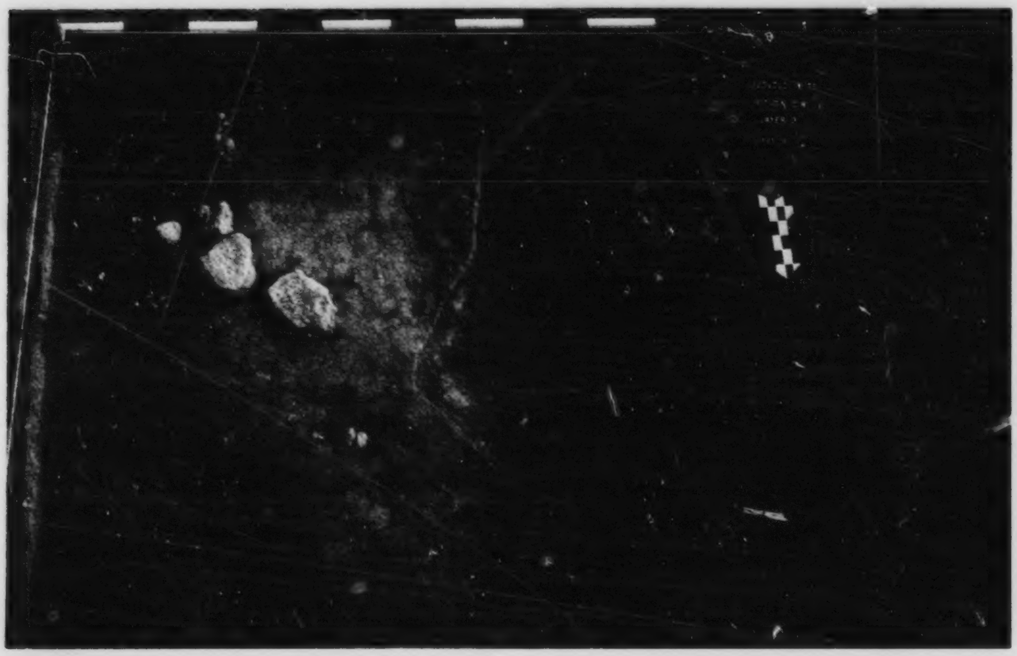


Figure 7.2. Feature F2-b (upper left) before exposure of hearth F2-a. Depression to the right is an infilled test pit dating to 1965. RSM #EiNs-4:70-082 CT.

spot. Meanwhile, a vessel could have been rested among the three stones at the south end of the workstation where its contents were kept warm with smaller pieces of coarse rock that had been heated on the fire and dropped inside. Alternatively, the smaller of the four large stones could have been used as hammers. The boiling-warming platform interpretation is reinforced by the fact that the south end of the feature is comprised mostly of small angular pieces of fire-cracked rock and one medium/small coarse rock. The void to the west of F2-b could have been where a fireside worker sat. A slightly different interpretation for F2-b would be that the larger rocks served partly as a workstation and partly as props or weights with which a stick was inclined over the fire to heat something. On the other hand, the charcoal patch/post mold to the south might have been the seat of an inclined hearth stick. The first interpretation, anvil and vessel boiling/warming site, seems somewhat more likely when one brings the next feature into the picture.

Feature F2-c was a scatter of artifacts in a rough tear-drop configuration measuring approximately 225 cm x 155 cm. Its broad eastern end, truncated by the Sjovold test pit, may have reached to the void southwest of F2-b. The underlying matrix was buff-coloured sandy soil like that of the general occupation surface. Most of the materials it contained were found at depths of about

35 cm below surface, but some smaller pieces were found as deep as 46 cm. The remains included two medium (35 cm diameter) and two small (15 cm diameter) concentrations of potsherds, several small angular pieces of coarse rock, two medium and numerous small fragments of bone, and five or more pieces of chipping debris. The great majority of potsherds in F2-c are from one vessel (vessel C). The only other traces of that vessel were found around F2-b (two crumbs) in XU 1 and in XU 5 (two crumbs) immediately south of F2-c. Feature F2-c also contained a trace (four sherds) of another vessel (vessel B) whose main concentration of sherds lay to the west in F2-d. We think that this feature can be interpreted as a "toss zone" created by a person sitting in the void between F2-b and F2-c and working at F2-b. It is noteworthy that larger items of broken bone and rock were farthest away from the void. One might expect larger items to be tossed farthest. The area nearest the void contains the smallest items and densest concentrations. This is also consistent with being at the near side of a toss zone.

Feature F2-d, situated a little more than a meter west of F2-c, was another surface scatter of artifacts. It was elongated north to south, irregular in form, and measured about 190 cm x 110 cm. We presume that it was completely exposed in XU 3, but that is not beyond doubt. Being defined solely by the presence of artifacts, and with artifacts being quite sparse, it is difficult to be certain where the boundaries lay. Given the present definition, the feature can be divided into two subareas (see Fig. 7.1). A southern subarea contained two small clusters of potsherds mixed with a few small bone fragments, a few pieces of charcoal, and a couple of chipped stone flakes. In the northern subarea a medium-size rock (12 cm diameter) sat at the boundary between north and south subareas; a large flat rock (33 cm long) rested at about the center of the subarea accompanied by several small fragments of bone on its west side, a few sherds of pottery 5 cm south and another small bone fragment about 17 cm north; and a another large rock (17 cm long) sat near the northern extremity with a few chipped stone flakes about 10 cm to the south and a MURL about 15 cm to the north. Between F2-d and F2-c was a void a little more than a meter in width and 2 m in length.

We interpret F2-d as having been a work station and lounging area of the kind often found immediately outside the door of a tipi. The large rocks in the northern area may have been anvils on which bones were broken or on which some stone chipping was also done. A clay vessel of soup or stew and a couple of boiling stones might have been kept close at hand for snacking. Meanwhile, the southern subarea might have been a discard area or toss zone for refuse generated in the northern subarea. Where the lounger(s) sat is not clear. The void between F2-c and F2-d is a possible location, but it could equally have been a path, possibly from the entrance of an adjoining shelter. It is interesting to note that the potsherds from F2-d were all from a single incomplete vessel (vessel B). A few additional sherds of vessel B were recovered in XU2, possibly in feature F2-c.

Discussion: The four features exposed in Layer II included a hearth, a fireside workstation, an associated toss zone and a slightly more distant lounge/work and discard area. Altogether these form a complex of activity areas which were likely situated outside a dwelling. In view of its size, it is unlikely that this complex was contained within a single dwelling. It is equally unlikely that the

Table 7.2. Coarse rock from Layer II.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
chert	-	-	-	1	-	-	1
concretion	1	-	-	-	-	-	1
gneiss	-	1	4	-	-	-	5
granite	52	4	1	-	1	1	59
limestone	1	-	1	-	-	-	2
mudstone	-	1	-	-	-	2	3
quartzite	-	-	-	1	-	-	1
quartz	-	-	-	-	1	1	2
sandstone	-	-	-	-	1	-	1
unidentified	7	2	2	4	4	3	22
Total	61	8	8	6	7	7	97
Weight							
chert	-	-	-	1	-	-	1
concretion	1	-	-	-	-	-	1
gneiss	-	193	2	-	-	-	195
granite	209	10	64	-	56	2	341
limestone	2	-	*	-	-	-	2
mudstone	-	2	-	-	-	1	3
quartzite	-	-	-	68	-	-	68
quartz	-	-	-	-	1	1	2
sandstone	-	-	-	-	36	-	36
unidentified	8,870	425	1,950	32	9	3	11,289
Total	9,082	630	2,016	101	102	7	11,938

complex could have been divided between the interiors of two dwellings because of the close proximity that would require. Rather, this complex is what one would expect for the area extending from just outside the doorway of a Plains Indian tipi to a nearby open air kitchen area. If such an interpretation is correct, then the tipi would have stood immediately north of XU 3, adjoining F2-d, and would have faced the creek. Going one step further, one might deduce that the occupation occurred in fair weather since cold weather would have kept people inside.

Rock

The coarse rock sample included some 97 specimens weighing approximately 11.9 kg (Table 7.2). The need for approximation arises because we discarded the larger pieces in the field. By way of explanation, Layer II was the first exposure in which we encountered a large heavy coarse rock sample. After exposing, mapping and photographing the material *in situ*, we thought about the crowded storage facilities at the Saskatchewan Museum of Natural History and decided to discard pieces larger than the size of one's fist (100 mm). Coarse rock from layers II and III were subject to that kind of discard. Shortly after finishing Layer III we regretted the culling as we began to reconsider our objectives and methods. The consequence was that for subsequent excavations all coarse rock was either preserved or else studied in detail before disposal. In order to reconstruct what has been lost by discard we compared the Layer II and Layer III planviews and photographs against the rock collections that were saved and have determined that, for Layer II, nine rocks larger than 10 cm in diameter were discarded. Further study allowed us to estimate the weights of discarded rocks. Although photographic records also provided an indication of the material types which were discarded (most in Layer II appear to have been granite or gneiss), we decided that such identifications were inadequate and have recorded the material types as unidentified. Table 7.2 shows the combined inventory of coarse rock from Layer II.

Large and medium-size rocks dominated the assemblage. The balance, all small pieces, were mainly fire-cracked rock. In particular, the granite, sandstone and limestone portions show colour change or angular breakage indicative of firing. The remainder falls into a residual category being either constituent pieces of the natural matrix or unexplained occupation debris. It is interesting to note that for XUs 4-6, where all coarse rock was saved, the total amount was very small, indicating that there was little extension of XU 1-3 features and related activities in a southward direction.

Pottery

Vessel B (Tables 7.3, 7.4) was a medium-size thin-walled pot about 22 cm in outside diameter and about 15-18 cm in height. We found substantially less than half of its sherds, mainly in the southern half of feature F2-d, but some were in a tight reconstructable cluster in the northwest part of F2-c (see Fig. 7.3). Sherds range from a few mm to several cm in length, and 2-9 mm in thickness. The largest reassembled piece, a segment of the shoulder, neck and body, measures 12 x 7.5 cm (see Fig. 7.4). The walls slope inward from the shoulder, both toward the base and toward the neck constriction, forming an angle of about 110°. The thickest part of the wall is at the shoulder where it appears that a separate neck/rim has been attached to a cup-shaped body and base. The thinnest part of the vessel wall is at the neck/rim juncture, about 10-20 mm away from the shoulder/body juncture. The paste is somewhat granular, laminated in places, and tempered sparsely with crushed granite. The exterior surface is grey (10YR 6.5/1) to very dark grey (10YR 3/1). It is completely covered with vertical cord impressions which have been slightly smoothed. At one place on the shoulder ridge there are three adjoining finger/thumb pinch marks. This horizontal sequence of pinch marks is reminiscent of the "quartering" decorations sometimes seem on the rim, neck, or shoulder of northern Plains miniature (sometimes called mortuary) vessels (e.g. Hanna 1976:16-18, 35-39; Syms 1979:290-291). The interior surface is smooth and gently undulating. It varies from black (2.5Y 2/0) to greyish brown (10YR 5/2). Most of the interior is covered with a thin black residue.

Table 7.3. Layer II potsherds by vessel and excavation unit.

Sherds	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
vessel B	-	7	89	-	-	-	96
vessel C	2	219	-	-	2	-	223
unclassified	1	-	-	1	-	-	2
Total	3	226	89	1	2	-	321
Weight							
vessel B	-	61.1	167.5	-	-	-	228.6
vessel C	0.6	92.8	-	-	0.8	-	94.2
unclassified	3.4	-	-	2.2	-	-	5.6
Total	4.0	153.9	167.5	2.2	0.8	-	328.4

Table 7.4. Layer II potsherds by vessel and part.

Sherds	Rim	Neck	Shldr	Body	Base	Crumb	Total
vessel B	-	4	1	52	3	36	96
vessel C	-	3	5	46	-	169	223
unclassified	-	-	-	2	-	-	2
Total	0	7	6	100	3	205	321

Vessel C is a smooth thin-walled pot broken into very small pieces of which we recovered less than half. Most pieces were in feature F2-c, but some were clustered around the bases of fireside rocks in F2-b. The two largest reconstructed sections are a segment of the neck/rim juncture 45 mm long and a 55 x 45 mm rectangle of the body. From the neck/rim section we estimate that the minimum inside diameter (at the narrowest point of the neck) was about 11 cm. Individual lip, rim, neck, shoulder and body sherds allow us to infer a complex wall profile somewhat like that of vessel B. It appears that the pot had a slightly flaring rim. The lip is squared and has a very slight interior flange. The lower part of the neck, the most constricted part, is marked on the inside by a ridge separating neck from shoulder at an angle of about 110°. The shoulder slopes downward and outward to the juncture with the body where there is a rounded exterior ridge with an angle of approximately 135°. From that ridge the body extends downward and inward toward a base that we were not able to reconstruct.

The thickest parts of vessel C are the neck/shoulder and shoulder/body junctures at about 8.5 mm each, while the thinnest part is the central body wall at about 3.5 mm. The neck is about 6 mm thick and the lip about 7.7 mm. The paste is laminated and somewhat granular with crushed granite temper (feldspar and quartz predominating). The exterior surface is plain and smoothed, in places polished, with a colour that varies from light grey (10YR 7/1) to light brownish grey (10YR 6/2). The

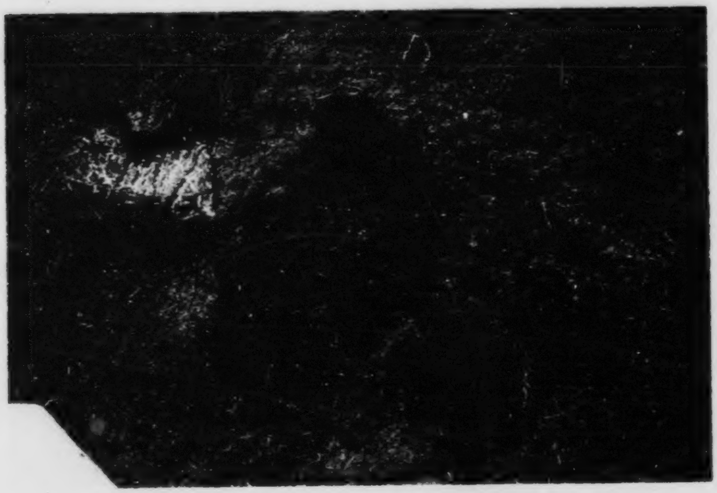


Figure 7.3. Sherds from neck/shoulder section of vessel B in the northwest corner of feature F2-c. RSM #EiNs-4:79-095 CT.

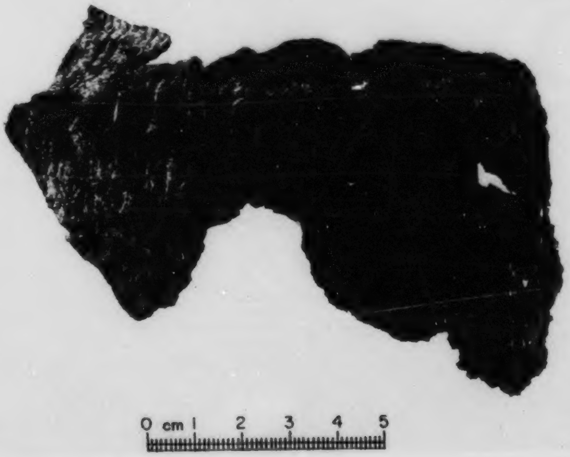


Figure 7.4. Reconstructed neck and shoulder segment of vessel B including sherds from features F2-c and F2-d (EiNs-4:459, 462).

interior is also smooth, less so than the exterior, and is predominantly light yellowish brown (10YR 6/4). Decoration is comprised of small "v" shaped impressions at intervals along the exterior edge of the lip (known only from sherds in the backfill of the Sjovold brothers' test pit) and, possibly, of exterior finger-tip punctates with matching interior bosses in a horizontal line along the neck/shoulder juncture. The sample contains only one half of one punctate (and boss) on one very small sherd. Hence the uncertainty about that element of decoration. There is no black residue evident on any surface of this vessel.

Unclassified sherds (n=2) include a body or basal sherd (catno 422a) with a smooth exterior surface, greyish brown (10YR 5/2), thickness of 8 mm, with a grey/black core, hard fine paste, and a smooth interior surface coloured reddish brown (5YR 5/3); plus one body sherd (catno 2034) from XU 4 with a smooth pale brown (10YR 6/3) exterior surface, thickness of 6 mm, fine hard grey paste, and smooth interior surface encrusted with a charcoal residue.

Discussion: Vessels B and C seem to have been roughly the same size and shape but they had distinctly different surface characteristics. Vessel B, with its vertical cord impressions, grey-black exterior and encrusted black interior appears to have been used to cook a substance to the point of carbonizing the parts which either touched or clung to the wall. This implies either intense or prolonged exposure to heat, as might have occurred had the vessel rested in, over or near a hot cooking fire. Yet, vessel B was found not in a hearth, but rather in the discard area farthest from the only hearth in the exposure. Meanwhile, vessel C, whose provenience indicates it was either used or disposed of in proximity to fire, shows none of the black interior encrustation. Vessel C sherds were found mainly in the F2-c discard zone and partly among the rocks of F2-b at the edge of hearth F2-a. Vessel C is also different in that its surface finish is smooth rather than cord-impressed. One explanation for these variances is that the two pots represent two functional types: (1) a cooking vessel for a wet organic substance (e.g. soup, stew) in the case of vessel B and (2) a rigid container (e.g. for water) in the case of vessel C.

Layer II pottery is remarkably similar to pottery of the Moose Jaw complex (culture) as known from the Mortlach site and from other southcentral Saskatchewan sites (Wettlaufer 1955; Malainey 1991). Vessel B corresponds to Wettlaufer's (1955:27) Moose Jaw Cord-Marked type whose characteristics include grit temper, grey-black colour, exterior vertical cord impressions, exterior lip notches, thickened shoulders with fingernail impressions or pinching, and body sherds 4-6 mm in thickness. Vessel C appears comparable to Wettlaufer's (1955:28) plain-surfaced variant of the Moose Jaw Cord-marked type. In a recent review of late prehistoric and protohistoric ceramics of south central Saskatchewan, Mary Malainey (1991) has resurrected Wettlaufer's Moose Jaw ceramic types and has amplified the distinction between them and ceramics belonging to the Mortlach culture, or Mortlach Aggregate as it has recently become known (see Joyes 1973; Syms 1977; Schneider and Kinney 1978; and Meyer and Epp 1990 for descriptions of Mortlach phase/aggregate pottery and its distribution). Malainey proposes that Alice Kehoe's (1959) term, Wascana Ware, be used as the covering term for pottery which includes that associated with Wettlaufer's Moose Jaw complex.

Malainey (1991:369) ascribes the geographic center of Wascana Ware distribution to the area between the parklands on the north, the Qu'Appelle River Valley on the south, the Touchwood Hills on the east and the Missouri Coteau on the west, an area which encompasses the Sjovold site. She suspects that the makers of Wascana ware were the Atsina.

Malainey's review of Moose Jaw pottery, Wascana Ware, is extremely helpful in the identification of Sjovold Layer II ceramics. However, we are not convinced that Atsina is the correct ethnic identification. An alternative possibility is that makers of Wascana Ware were Assiniboines. One line of supporting evidence is similarities (such as notched lips, vertical cord markings, common straight rim profile, and colour) between the Wascana Ware types, Moose Jaw Cord-marked and Moose Jaw Plain, and the most common corded and smoothed types of Sandy Lake Ware to the southeast (Cooper and Johnson 1964; Anfinson 1979). Given such similarities, it seems plausible that Sandy Lake Ware and Wascana Ware are related to one another. Scholars familiar with Sandy Lake Ware have attributed it to the Wanikan Culture which they believe was a Siouan-speaking group, either proto-Assiniboine or proto-Eastern Dakota (see Anfinson 1979:176; Rajnovich 1988). Another line of evidence is the distribution of Wascana Ware. There is a high degree of overlap with the known distribution of Assiniboine Indians in central Saskatchewan at the time of European contact (cf. Russell 1991:176-186). If Wascana Ware was made by western Assiniboines, then Sandy Lake Ware still could have been made by either eastern Assiniboines or by proto-Eastern Dakota. As to the age of Layer II, that could be an indication for an earlier Dakota/Assiniboine split and an earlier movement of Assiniboines into Saskatchewan than the near-1600 AD date which is often cited. A final point concerns the appearance of fabric-impressions in both Selkirk and Wascana ware ceramics (Kehoe 1959:244; Malainey 1991:10-11). Such occurrences led Kehoe to the false conclusion that Wascana ware and Selkirk were more similar than they are, and that both were attributable to Cree Indians. It is our view that the occasional appearance of fabric impressions on Wascana ware pottery could be an indicator of Cree/Assiniboine interaction, a consequence of the ancient and well-known Cree/Assiniboine alliance.

Stone Tools

MURLS (n=3). Two MURLs (catnos 437, 2033) were made on thin expanding flakes of Knife River Flint (Table 7.5). Catno 437 was situated in the center of hearth F2-a, yet it does not appear to have been altered by heat. It exhibits fine unifacial retouch on alternate faces of the two edges leading to a 3 mm long striking platform. The retouched edges are slightly dulled, presumably by use as a razor blade-like cutting edge on a soft material such as meat or leather. Catno 2033, a similar tool based on a similar flake, was found in screenings of XU 4 immediately south of F2-a. It exhibits what appears to be use wear or edge crushing along the useable portion of one lateral edge. A third MURL, Catno 453, was found at the north edge of F2-d in XU 3. It is a plano-convex decortication or core preparation flake of grey, white and brown Swan River Chert with short unifacial flake scars, possibly due to use wear, on the thinnest part of its edge. It, too, though substantially larger than the other

Table 7.5. Stone tools from Layer II.

Type	Catno	XU	Weight	Length	Width	Thickness	Material	Whole
MURL	437	1	1.2	28	21	3	Knife River Flint	y
MURL	453	3	36.7	52	42	16	Swan River Chert	y
MURL	2033	4	0.8	21	13	2	Knife River Flint	n

Table 7.6. Chipped stone debris, excluding the core, from Layer II.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
agate	1	-	2	-	1	-	4
andesite	-	1	-	-	-	-	1
chert	2	-	2	-	1	-	5
chalcedony	-	1	-	-	-	-	1
Gronlid Siltstone	12	-	-	-	-	-	12
Knife River Flint	-	-	1	-	-	-	1
petrified peat	-	-	-	1	-	-	1
quartz	15	-	1	-	-	-	16
unidentified	3	-	-	-	-	-	3
Total	33	2	6	1	2	-	44
Weight							
Agate	0.2	-	0.2	-	0.7	-	1.1
andesite	-	0.1	-	-	-	-	0.1
chert	0.5	-	0.2	-	0.7	-	1.4
chalcedony	-	0.2	-	-	-	-	0.2
Gronlid Siltstone	10.6	-	-	-	-	-	10.6
Knife River Flint	-	-	0.2	-	-	-	0.2
petrified peat	-	-	-	6.9	-	-	6.9
quartz	28.5	-	2.0	-	-	-	30.5
unidentified	2.8	-	-	-	-	-	2.8
Total	42.6	0.3	2.6	6.9	1.4	-	53.8

MURLs, may have served, briefly, as a cutting tool.

Chipped Stone Debris

The Layer II sample includes 44 pieces of shatter and flakes and one possible core or core fragment (Table 7.6). The suspect core (catno 441) is mottled grey, buff/white chert, weighs 4.4 g, measures 22 mm in greatest dimension, and was found in XU 2. Approximately one half of its surface appears to retain the roughened pebble cortex while the other half is covered with flake scars which may reflect a bipolar kind of reduction. It is possible that this item is a natural part of the soil matrix. The balance of the Layer II sample is mainly the chipping debitage from a piece of fine black Gronlid Siltstone and from several pieces of white to smoky black quartz, none of which is represented by recovered tools. There is a slight degree of correlation between debris and tools in the case of Knife River Flint, there being two tools and two flakes of this material. The flakes, however, are bifacial thinning flakes and therefore are derived from tools other than the ones we recovered. The great majority of chipping debris was found in XU 1 in the vicinity of features F2-b and F2-a from which we infer that most of the chipped stone tool manufacture and repair took place there.

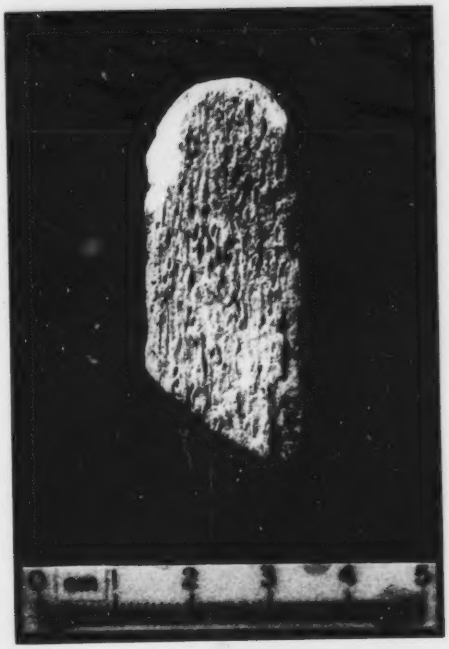


Figure 7.5. Bone pressure flaker from Layer II (EiNs-4:435).

Bone Tools

Two pressure flakers are made on large mammal rib fragments (see Fig. 7.5). Catno 435, from XU 1, is 51 mm long after breaking while the bone was still fresh, presumably during use. Its faceted working tip is semicircular in outline and is beveled toward the medial side of the rib. Catno 8070, from XU 2, is a small fragment, 23 mm long, with an unbeveled facet on an oblique fracture surface.

Faunal Remains

Approximately 250 g of large mammal bone from XUs 1-3 were sacrificed for a radiocarbon date (S-1758) prior to the analysis. Most of the sample came from XU 1, and a thoracic vertebra from XU 2 was also included.

Bison, NISP=6: mandible containing $M_{2\cdot3}$ ♀ (AG 8), lower premolar fragment, distal humerus ♀/$^{\odot}$, ulnar semilunar notch, acetabulum with pubis, proximal femur ♂. The humerus is of the right size to be from the same cow as the mandible. The mandible bears a dismemberment cut mark on the posterio-lateral surface of the ascending ramus (see Binford 1981: Table 4.04, M-2). The femur preserves a point of impact on its medial surface adjacent to a mid-shaft fracture, and it was probably

Table 7.7. Vertebrate remains from Layer II.[a]

Size, Taxon	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
6, Bison	1	1	3	-	1	-	6
5-6, mammal	2	3	6	5	5	3	24
5, Deer	-	-	-	-	-	1	1
3, Showshoe Hare	-	1	-	-	-	-	1
2, Ground squirrel	*4	-	-	-	-	-	4
-, mammal	5	18	63	39	35	44	204
Bird eggshell	-	-	+	-	-	-	+
Total	12	23	72	44	41	48	240
Weight							
6, Bison	1.0	374.5	630.5	0.0	36.0	0.0	1,042.0
5-6, mammal	8.1	4.4	11.6	54.0	40.6	9.2	127.9
5, Deer	-	-	-	-	-	6.2	6.2
3, Snowshoe Hare	-	0.1	-	-	-	-	0.1
2, Ground squirrel	1.3	-	-	-	-	-	1.3
-, mammal	1.0	3.3	17.7	17.0	20.5	14.3	73.8
Total	11.4	382.3	659.8	71.0	97.1	29.7	1,251.3

a. Superscript (*) signifies that these elements are thought to be intrusive into this layer.

Table 7.8. Modified vertebrate remains from Layer II.[a]

								Fracture States				
Size, Taxon	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	-	-	2	-	5	5	1	-	1	4	-	6
5-6, mammal	3	3	4	-	*	*	1	-	4	19	-	24
5, Deer	-	-	-	-	-	1	-	-	-	1	-	1
3, Snowshoe Hare	-	-	-	-	-	-	1	-	-	-	-	1
2, Ground squirrel	-	-	-	1	-	-	-	-	-	-	4	4
-, mammal	2	20	-	27	*	*	-	*	*	*	-	204

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

broken for marrow recovery. The proximal end of this bone has been furrowed by carnivore gnawing, but there are no tooth marks on the shaft near the fracture surface. The distal humerus is also furrowed by a carnivore.

Size 5-6 mammal, unidentified, n=24: one tooth, one vertebra, seven rib, 15 long bone shaft fragments. Three ribs exhibit cut marks, and two of them are classified as pressure flakers. Three long bone fragments are charred. One rib and three long bone fragments exhibit carnivore tooth punctures, and two of the long bones have rounded edges and tips adjacent to the tooth marks. They resemble bone tools but probably were modified entirely by carnivore tooth and tongue.

Deer, NISP=1: ulnar semi-lunar notch.

Snowshoe hare, NISP=1: P^3.

Ground squirrel, NISP=4: cranium with all alveoli and containing L M^{2-3}, atlas, acetabulum with ilium, femur. The cranium can be identified as Richardson's ground squirrel (*Spermophilus richardsonii*), and the scarcely worn teeth show that it died when very young. This is consistent with incomplete fusion seen in the cranial sutures, innominate and femur. The skull bones have separated at the sutures rather than by fracturing. Sutural separation is typical of owl-digested small mammal skulls, and further evidence of such digestion is seen in thinned high spots on the atlas vertebra.

Unidentified mammal, n=204: fragments less than 4 cm in length. Two specimens exhibit cut marks, but they are difficult to interpret without evidence of orientation and placement on a named anatomical part. Eighteen are charred, and two are calcined.

Bird, unidentified: eggshell fragments from XU 3. Judging from thickness measurements, these fragments were derived from the egg of a grouse-size bird (Table 5.3).

Snails, unidentified: five small gastropods were recovered by screening in XU 4.

Plant remains, unidentified: A small charcoal sample (23 fragments, 1.8 g) and one carbonized seed were collected from hearth F2-a.

Discussion: Portions of a bison bull and a bison cow were brought to the site by people who used the meat and the marrow. Two ribs were also used as tools to flake stone artifacts. The 23 charred and calcined specimens show that some bone was exposed to fire, but the remains are not closely associated with the surface hearth in XU 1 where only six burned specimens were found; selection of the radiocarbon sample, largely from XU 1, may have influenced this pattern. The majority of burned specimens (15) were recovered from XU 3, possibly indicating another hearth nearby but beyond the excavation limits.

It is possible that the deer and snowshoe hare were retrieved through subsistence pursuits, but this cannot be determined with certainty from only one specimen of each. We are more certain about the ground squirrel that appears to have fed an owl rather than the human occupants of the site. The concentration of ground squirrel remains in XU 1 suggests deposition in a single owl pellet (but see below).

Either during the human occupation or after abandonment, carnivores fed upon the bison remains as shown by several tooth-marked and digested fragments. A concentration of 20 digested fragments in XU 6 may represent the contents of a carnivore scat.

People might have gathered the bird's egg, a carnivore might have found it, or the bird itself could have carried the eggshell to the site in order to dispose of it away from its nest. The choice of explanation would depend in part on the identity of the bird, which cannot be determined. If it is a ground-nesting grouse, it would be vulnerable to carnivore as well as human disturbance of the nest. Grouse, however, are precocial birds that are not nest-bound for long after hatching, and eggshell removal is less important to them than to altricial species. In any case, the eggshell reached the site during the summer season.

Interpretation of Layer II

Our exposure of Layer II revealed an outdoor kitchen and a nearby lounge area. The kitchen included three features and a void. The east to west arrangement was: a surface hearth, a fireside workstation comprised of several medium-large rocks, a void that presumably served as a sitting area, and a toss zone or discard area. Altogether this group measured about 4.5 m from one side to the other. About 1 m farther west was the lounge area which included at least one more void, which might have been either a path or another sitting area, and an adjoining discard feature about 2 m long by 1 m wide, oriented north-south, and containing bone, chipped stone, rock and ceramic debris. Immediately to the south of the lounge area was a small concentration of digested bone fragments, possibly the remains of a carnivore scat. The scat could have been left by a post-occupation scavenger or by a dog belonging to site occupants. The general orientation of the feature group was parallel to the creek bank.

Activities in the kitchen area could have been carried out by a person sitting in the void between the workstation and the discard area and may have involved: (1) (roasting? and) breaking a few marrow-rich bison limb bones using the rocks of F2-b as an anvil; (2) discard of broken bones into F2-c; (3) use and breakage of a small plain-surfaced pot near F2-b; (4) discard of parts of that vessel in F2-c; (5) use and discard of two sharp unifacially chipped flakes; (6) minor retouching of a biface tool(s); (7) chipping of Gronlid Siltstone and quartz, presumably for manufacture of tools which we did not recover; and (8) heating and use of several medium to small granitic rocks, presumably in a stone boiling or roasting process. The concentration of remains is about what might be expected for the activities of one person for several hours to, at most, a few days.

What we interpret as the lounge area is a little more difficult to decipher because the feature definition is not so clear or complete. We are assuming that most of the remains in F2-d are the result of activities which occurred within or adjacent to the feature. It is also possible that some remains represent activities which occurred at nearby features that we have not exposed (such as a speculative dwelling floor and a hearth to the north.) Given those provisos, activities which took place in or near the lounge area included: (1) a small amount of bone breaking; (2) use and discard of a flake knife; (3) a small amount of chipped stone tool retouching (tools not recovered); and (4) (use? breakage? and) discard of a small cooking pot whose interior was encrusted with black residue, possibly a stew pot whose contents were kept warm with a few hot rocks. The remains in the lounge area are indicative of activities which were less intensive but similar to those carried out in the kitchen area.

Ancillary activities implied by these remains include: (1) coarse rock collecting which almost certainly took place on the nearby creek or river beds or valley walls; (2) hunting, killing and butchering of a bull and a cow bison, possibly also a deer, which must have occurred off site, since so little of the bone is present; (3) acquisition of Gronlid Siltstone raw material (source 225 km NE); and (4) acquisition of KRF tools (source 600 km SE).

On the basis of the stratigraphic position and a single radiocarbon date, we estimate the age of Layer II at AD 1150-1350 (cal 800-600 BP; Table 3.6). The season of occupation may have been one of fair weather if the outdoor interpretation of features is correct. The presence of grouse-size egg shells, although not definitely tied to human behaviour, is a coincidental summer indicator. The length of occupation appears to have been quite short — on the order of days according to the small amounts of various remains.

There are several lines of evidence concerning the identity of site occupants. The ceramics are those of the Moose Jaw complex which we think may be associated with late prehistoric Assiniboine Indians. The appearance of Gronlid Siltstone and Knife River Flint certainly indicates that the inhabitants had access to good chipping materials in both northern and southern parts of the northern Plains region. It is a pity that no projectile points were recovered. However, the lack of projectile points does lead to consideration of another aspect of the identity, namely, group size and gender. First of all this assemblage appears to be the remains of a small party's activities. The bison and deer could have been killed, butchered and hauled back to camp by one or two hunters, while the kitchen and lounge activities could have been carried out by one or two women. We have the admittedly subjective feeling that it is women's presence which is most strongly expressed in these remains. This derives from the presence of ceramics which one would not expect in a strictly male party, from the complex kitchen area, and the absence of men's tools in it. There is no sign specific to young or adolescent children here, but that does not preclude their presence. There are at least two kinds of known Plains Indian groupings which could have produced such a package of remains: (1) a single family possibly consisting of a man, a woman, unmarried children, guests, and aged grandparents; and (2) a specialized hunting party consisting of two or more man-woman couples and no children (Wilson 1924:231-262).

Interlayer II/III

Features: The Sjovold brothers' test pit continued through this interlayer in XU 1.

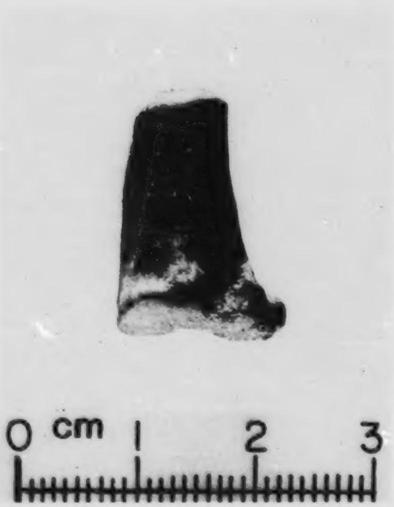


Figure 7.6. Lynx metatarsal broken by grooving and snapping, from Interlayer II/III (EiNs-4:492).

Rock: Sixteen pieces of coarse rock (one basalt, ten granite, one metamorphosed sandstone and four unidentified) weighing 1483 g were found in XUs 1 (1 g), 2 (112 g) and 4 (1369 g). The basalt specimen (catno 2061) is an oblong slab/cobble with large flake scars at one end which could be the result of natural battering or an indication of ad hoc use as a hammerstone or axe. The metamorphosed sandstone is a whole pebble with a buff/pink/grey hue possibly indicative of (brief) contact with fire. Finally, all of the granite is fire-broken. Taken together this material, mainly from XU 4, is a logical extension of the workstation and fire-broken rock comprising F2-a in XU 1. Its deeper provenience may be accounted for by rodent burrowing which was evident in XUs 3 and 4.

Pottery: Some 111 potsherds weighing 95 g were discovered in XU 2, and two crumbs weighing 0.6 g were found in XU 3. The sherds represent vessel B (one body, one crumb), vessel C (four neck, four shoulder, 36 body, and 65 crumbs), plus two unclassified crumbs. This pottery originated in Layer II. A substantial amount came from the base of the pottery cluster in F2-c, particularly at the interface with the Sjovold test pit. The balance reached the interlayer by processes unknown.

Chipped Stone Debris: Seven pieces of chipped stone weighing 4.2 g were found in XUs 1, 2 and 3. Included are one each of andesite, chert, petrified peat, quartz and silicified sediment plus two pieces of petrified wood, altogether comprising five flakes and two pieces of shatter. These materials are very similar to those of Layer II above and may have reached the interlayer by a combination of trampling and rodent burrowing.

Bone Tools: The proximal end of a lynx metatarsal from XU 2 (catno 492) has been grooved and snapped (see Fig. 7.6). Following Vickers (1989:121-123), we infer that this is a byproduct of bead manufacture, although no finished beads were found in the Sjovold site.

Biotic Remains: A small bone assemblage was recovered from XUs 1-3 in the interlayer.

Size 5-6 mammal, unidentified, n=10 (35.1 g): one tooth, four rib, five long bone shaft fragments. Seven of these specimens were fractured when fresh.

Lynx, NISP=1 (1.5 g): proximal metatarsal III. This bone, from XU 2, has been grooved and snapped, apparently as a byproduct of bone bead manufacture. It also exhibits superficial rootlet etching.

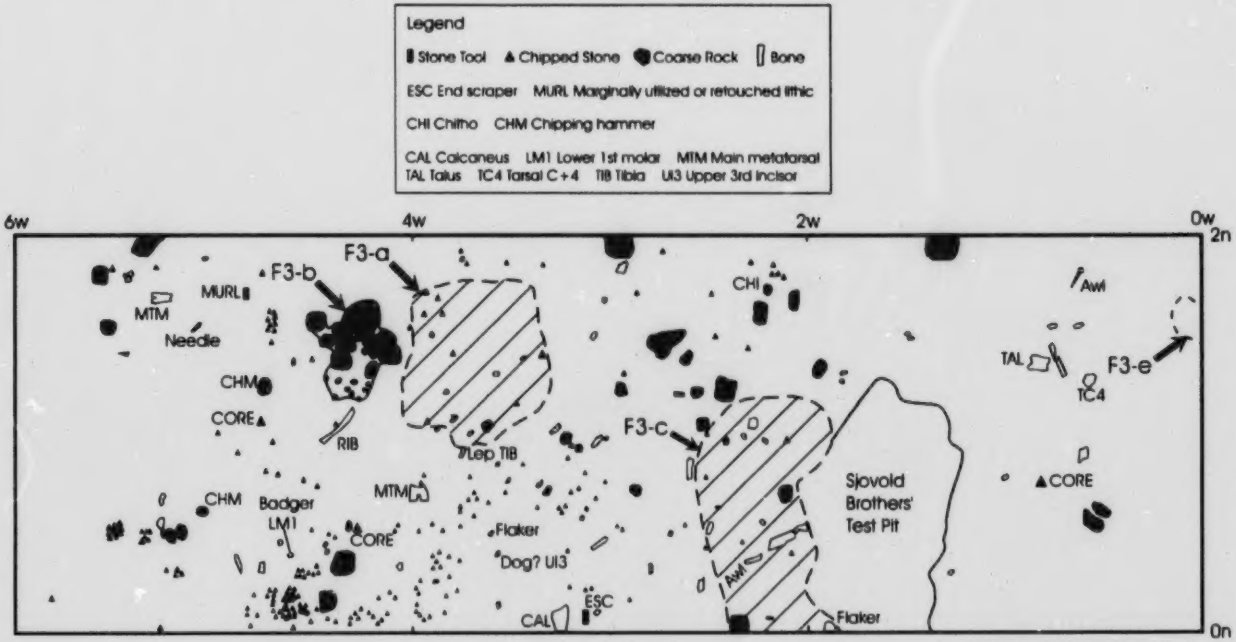
Size 3 mammal, unidentified, n=1 (0.2 g): long bone shaft fragment. This fresh-fractured (leporid?) bone from XU 1 exhibits both a carnivore tooth puncture and evidence of digestion.

Ground squirrel, NISP=5 (0.3 g): two mandible fragments, thoracic vertebra, lumbar vertebra, scapula. Four of these specimens occurred in XU 1 and probably belong with the ground squirrel remains in Layer II of the same unit. The thoracic vertebra came from XU 2 and shows evidence of digestion that may also link it with the Layer II remains.

Unidentified mammal, n=55 (9.0 g): fragments smaller than 1 cm in length. XU 2 yielded 14 fragments with evidence of digestion and one fragment that is charred.

Charcoal: A small sample (22 pieces, 1.3 g) was recovered by screening in XU 2.

Discussion: Probably most of these specimens were trampled down from Layer II. The concentration of digested fragments in XU 2 may represent the contents of a carnivore scat. The ground squirrel remains probably belong to the same individual seen in Layer II, but, rather than being trampled down, they may have been deposited in a burrow (see below).


Legend
Stone Tool
Chipped Stone
Coarse Rock
Bone
ESC End scraper
MURL Marginally utilized or retouched lithic
CHI Chitho
CHM Chipping hammer
CAL Calcaneus
LM1 Lower 1st molar
MTM Main metatarsal
TAL Talus
TC4 Tarsal C+4
TIB Tibia
UI3 Upper 3rd incisor
6w
4w
2w
0w
2n
0n
F3-a
F3-b
F3-c
F3-e
MURL
MTM
Needle
CHM
CORE
RIB
Lep TIB
MTM
CHM
Badger
LM1
CORE
Flaker
Dog? UI3
CAL
ESC
CHI
Awl
Sjovold Brothers' Test Pit
Flaker
Awl
TAL
TC4
CORE

Planview by ID. Corel rendition by REM

Figure 8.1. Planview of Sjovold Layer III.

Chapter 8

Layer III: A Moose Jaw Campsite

Introduction and Planview

Layer III was comprised of two occupations. Layer IIIa was situated 45-48 cm BS at 2n2w and associated with buried soil horizon Ahb2. It contained a trace of occupation debris and no features. Layer IIIb, situated at 50-55 cm BS at 2n2w and associated with buried soil horizon C3, contained substantial samples of both features and occupation debris. We were unable to isolate the small IIIa sample during excavation. Consequently, materials from IIIa and IIIb are described together here, as if they were from one layer. Given the overwhelming predominance of Layer IIIb materials, the description and interpretation which emerges below can be regarded a nearly accurate depiction of Layer IIIb, one which is only slightly adulterated by Layer IIIa materials. A radiocarbon date on bone from Layer IIIb indicates an age for the occupation in the range of AD 850-1250 (Table 3.6).

There was a extensive horizontal rodent burrow, about 5-10 cm in diameter, in the southeast quarter of XU 1. In an least three places the burrow widened and deepened to form chambers about 25 cm in diameter. There were other burrows in XU 3, but the diffuseness of the soil colours in that area made them difficult to define. Upward and downward diffusion of the dark brown and grey-brown colours of the Ahb and C horizons suggest that other deposit-modifying forces such as ground water percolation, freeze-thaw, or insect burrowing may have been at work. Interlayer III/IV, situated 55-63 BS at 2n2w, was a buff-coloured sandy silt deposit.

The planview shown in Figure 8.1 is focused on Layer IIIb and excludes items known to belong to Layer IIIa (see also Fig. 8.2). In addition to the Sjovold brothers' test pit, five features are described for Layer III, and four of these are labelled on the planview; the other feature (F3-d) is the general artifact scatter seen between 2w and 6w. Stone tools include two chipping hammers, a chitho, an end scraper, and a MURL. Five bone tools are visible on the planview including two awls, two pressure flakers, and a possible needle. Bison bones are represented by a rib, a calcaneus, a talus, a tarsal C+4, and two distal metatarsals. In addition there is a leporid (Lep) tibia, a canid (Dog?) upper third incisor, and a badger lower first molar.

Features

Feature F3-a (Figs. 8.1, 8.3; Table 8.1) comprised a thin rounded square of charcoal-stained and ashy soil underlain by a slightly smaller but thicker layer of charcoal-stained soil which, in turn, was underlain by a small central lens of reddened soil. Altogether the feature was about 8 cm thick.

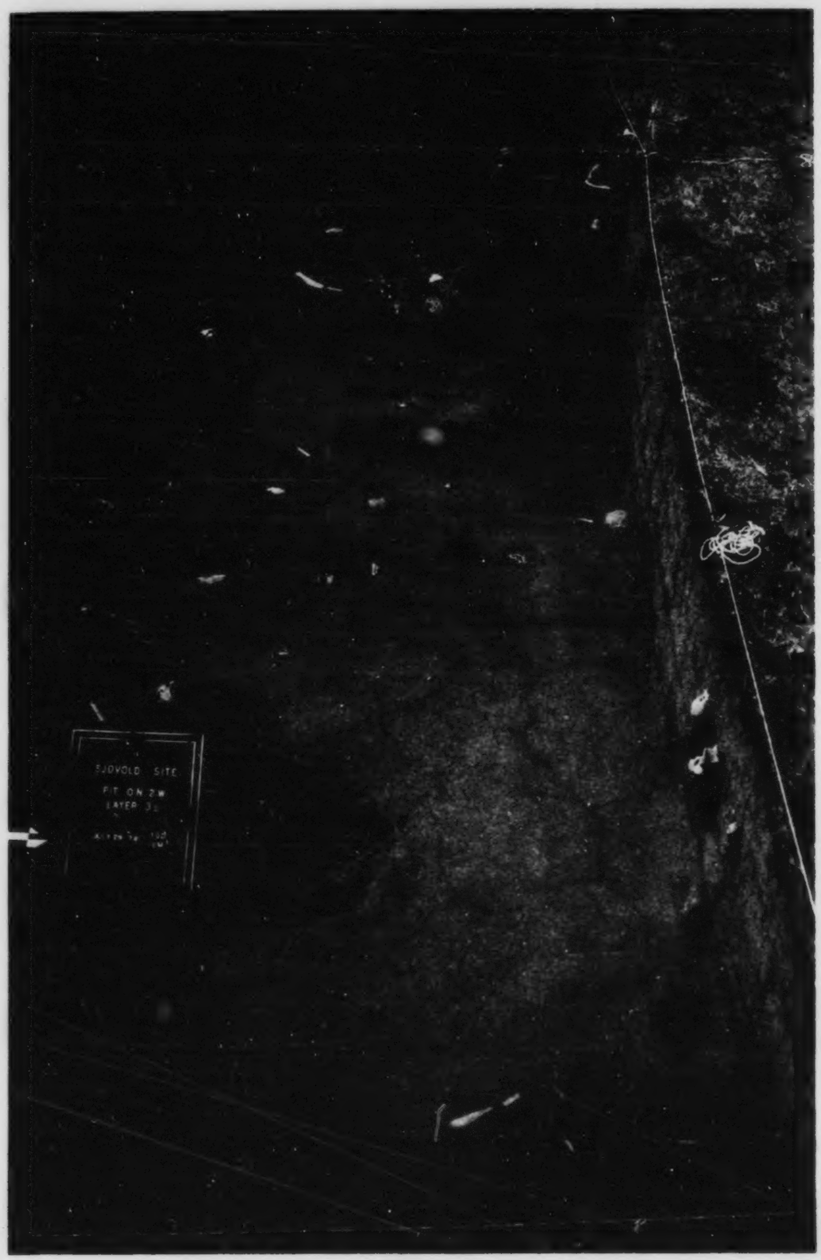

SJOVOLD SITE
PIT ON 2W
LAYER 3

Figure 8.2. Basal aspect of Layer IIIb. F3-a hearth and associated F3-b rock cluster are near the top. RSM #EiNs-4:79-110 CT.

Table 8.1. Features in Layer III.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F3-a	surface hearth	135n370w	84	75	8
F3-b	rock cluster	140n425w	39	45	0-12
F3-c	surface hearth	55n215w	>115	>55	7
F3-d	artifact scatter	75n350w	>200	>395	>2
F3-e	charcoal soil	160n5w	24	>15	1

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

The margins, both in plan and profile, were fuzzy. Within and on top of the charcoal-ashy portions lay more than 450 pieces of chipping debris (petrified peat, quartzite and chert), some of them obviously heat-altered, plus one small side-notched projectile point, a large piece of schist, several small pieces and pebbles of coarse rock, and some 360 fragments of burned and calcined bone. Taken together, these attributes are indicative of a surface hearth which also served as a disposal area. The broadest charcoal and ashy zone was at the same level as the base of an adjoining rock cluster (F3-b) which, we presume, was the living surface at the time of occupation. The underlying charcoal-stained and reddened layers were below surface at the time of occupation and presumably were created by the heat of the hearth. It does not appear that the hearth had been maintained, that is, that accumulated materials had been scooped out. However, artifacts found on the hearth surface and up to several centimeters below reflect some sort of minor mixing during occupation. A few pieces of charcoal less than 1 cm in length amid a patch of charcoal-stained earth about 75x25 cm were encountered directly over and as much as 3-4 cm above the hearth/occupation surface. This material was not included in the 8 cm estimate for thickness. It indicates that there was a slight mound of combustion materials left in place at the time of burial, and that at least some of the fuel was wood.

Feature F3-b, a rock cluster immediately west of hearth F3-a, was dominated by two rock cobbles (see Fig. 8.3). The largest, apparently a grey and white gneiss about 22 cm in diameter, rested at the north edge some 20 cm west of the hearth. At the highest point it had rounded corner from which a flat face sloped downward toward the hearth and toward the other large rock only 2 cm to the southeast. The second rock was about three quarters the size of the first, sat between the first rock and the hearth, and was also a grey-white granular material, either granite or gneiss. It too had a sloped upper face which was opposite to the first rock and created a basin between them. Almost touching the western edges of the two large rocks was a cluster of medium and small pebbles and fragments of rock, including four or five medium-size fragments of buff-grey fire-broken granite, five or six small fragments of the same material, a couple of small (3 cm diameter) smooth black pebbles, and a medium-size weathered fragment of ivory-coloured limestone. About 20 cm SW of this cluster was a medium-size black-green cortical fragment of what appears to be basalt or andesite. A little farther south was another cluster consisting of one medium-size grey rock fragment and about 12 small pebbles and fragments, apparently a mixture of granite and limestone. It is difficult to decide exactly

Figure 8.3. Close-up of F3-a hearth (middle) and associated F3-b rock cluster.
RSM #EiNs-4:79-119 CT.

where the feature ends since other materials, bone and stone, are scattered nearby. We believe that the rocks described above are the essence of the feature which was about 45 cm in diameter and situated about 10 cm west of hearth F3-a.

The function of this rock cluster is a puzzle. The sloping upper surfaces of the large rocks would not have made good working surfaces for jobs such as stone chipping or bone breaking. Indeed, the complete absence of bone and chipped stone debris among these stones and their abundant presence in nearby areas argues against the use of F3-b as that kind of workstation. Another possibility is that rocks surrounded, protected or propped up an inclined stick which may have been stuck in the ground so that it leaned over the fire. However, the arrangement does not seem appropriate for this interpretation. Yet another possibility is that the rocks formed a basin within which some form of vessel was rested while medium and small pieces of rock were alternately heated on the fire and then dropped in the vessel in a stone-boiling process. There was remarkably little fire-broken rock in the hearth, but the medium and small pieces around the base of the two large rocks certainly could have served such a task. This last possibility is not completely satisfactory as an explanation for F3-b, but it seems the most plausible of the ideas presently at hand.

Feature F3-c, a second area of charcoal and burned soil was situated about 1 m southeast of F3-a in the southeast corner of XU 2. Our view of it is incomplete, representing about 55% of the feature's surface area with about 30% having been lost to the Sjovold test pit and another 15% to our rapid excavation of XUs 4-6. What remains is a layer of charcoal-stained soil containing numerous small chunks of charcoal and occupying a roughly semicircular area about 90 cm in diameter and about 4 cm thick. That was underlain by a somewhat larger lens of golden-red soil about 4 cm thick and about 110 cm in diameter. The edges of both charcoal and golden-red soil patches were extremely diffuse. On the western edge of the feature there was a 5-10 cm wide fringe of bone and coarse rock fragments and several pieces of chipped stone debris marking the transition to a large surface scatter of occupation debris comprising feature F3-d. The elevation of the occupation surface at F3-c (marked by the contact between charcoal and golden-red soil) was about 5-6 cm higher than equivalent levels of F3-a and F3-b. However, the natural slope of the occupation surface easily accounts for this difference.

On the basis of the charcoal residues and underlying burned earth we interpret F3-c as a surface hearth. The chunks of charcoal in its upper zone indicate that wood was the fuel. The apparent lack of a middle charcoal and ashy "surface" zone is a difference from the structure of F3-a, as is the yellow hue and lack of charcoal and ash staining in the subsurface zone. Artifacts lying on and in the hearth included a minimum of five medium size bone fragments, one large disaggregated coarse rock and a couple of coarse rock fragments — a paucity of artifacts in comparison to F3-a. Evidently, F3-c was a somewhat different from F3-a, but we do not have the basis to press its interpretation much further.

Feature F3-d was a surface scatter of chipped stone, bone fragments, coarse rock, and stone and bone tools. Although not labelled, the exposed part of it is shown in Figure 8.1 forming an apron around features F3-a and F3-b and extending to the northwest edge of F3-c. From west to east it was about 4 m. North to south it occupied the whole 2 m span of XUs 2-3 and probably extended at least another meter south into XUs 5-6. It may also extend into the unexcavated area north of XUs 2-3. A comprehensive definition is precluded by the lack of piece-plotted information for XUs 4-6 and because the north and west borders of our excavations did not completely expose the feature. F3-d rested on and in the buff-brown sandy-silts of Layer IIIb. The feature sloped downward from northeast to southwest at a rate of about 1:19 in conformity with the slope of the paleosol of which it was part. Artifactual debris defining the feature was found through a vertical range of about 8 cm at any particular sublocality, presumably due to slight undulations in the surface and to dispersing mechanisms such as trampling and rodent burrowing. The debris included some 850 pieces of chipped stone, a chipped and notched stone axe, a large chitho, three endscrapers, seven MURLs, four chipping hammers, and the tip of a projectile point. It also included about 250 pieces and pebbles of coarse rock, several hundred fragments of bone, plus two bone awls, a possible bone needle and a bone pressure flaker.

A degree of subdivision within the feature is indicated by the concentration of debris in certain areas. For example, the great majority of chipped stone debris was found in the south central part of the feature in the vicinity of two medium-size coarse rocks. All four chipping hammers were found within about 1 m of this concentration, two in XU 3 and two in XU 5. Thus, it would appear that the south central area accommodated the greatest amount of stone chipping activities. Most of the MURLs were scattered through this same chipping concentration and beyond. There was a smaller concentration of chipping debris toward the east centre, roughly equidistant from the two hearths. That was also the location of the three endscrapers along with a few scraps of bone and a few coarse rock fragments. A third subarea was apparent in the northeast corner of the feature. Its major constituent was medium-size coarse rocks, but it also included a few pieces of chipping debris and bone. Our interpretation of F3-d is that was a living floor composed of several closely spaced working areas in which activities such as chipped stone tool manufacture and rejuvenation, hide preparation, cutting, sewing, bone breaking, bone roasting, stone boiling and meat consumption took place.

Feature F3-e was a 20 x 15 x 3 cm deep patch of blackened soil containing a few small pieces of charcoal. F3-e was situated in the northeast corner of XU 1 and only part of it was exposed in our excavations. The feature had a north-south profile which was roughly lenticular and perhaps somewhat flatter on top than on the bottom. The contextual information for F3-e consists of a sparse scatter of bone, coarse rock, pieces of charcoal, chipping debris, two MURLs, a moose bone splint awl and two rib bone pressure flakers which lay between F3-e and hearth F3-c. Evidently, F3-e was peripheral to F3-d. It may have been part of yet another hearth.

Discussion. The five features exposed in Layer III included two and possibly three hearths, a cluster of rocks near one of the hearths and a large scatter of occupation debris, probably a living floor. One of the hearths, F3-a, was a disposal area for some chipping debris and bone fragments. That may be evidence for the kind of maintenance activity that one would expect inside a dwelling. The variety of activities indicated in F3-d, the presence of small tools at the center of the activity area, and of larger tools toward the periphery may also be indicators that the features were indoors. If so, the dwelling or shelter was 4 m long and it may have contained more than one hearth.

Rock

Coarse rock included some 339 specimens weighing approximately 16.6 kg (Table 8.2). As for Layer II, these figures are a combination of direct observations on preserved specimens and weight estimates based on slides and planviews for 24 larger specimens that were discarded in the field. Material types for discarded specimens are listed as unidentified. The great majority of Layer III rock was located in four features, F3-a, F3-b, F3-c and F3-d. The granite and gneiss boulders at the heart of F3-b may have functioned as a prop or stage for a vessel in which a substance was boiled. The medium and small fragments of granite, limestone and basalt around the bases of the two bigger rocks may have served as fired rocks which broke during use in a stone-boiling process. We presume that most of the medium and small rock fragments found throughout the other three features were also

Table 8.2. Coarse rock from Layer III.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
amphibolite	1	7	-	-	-	-	8
andesite	-	1	2	-	-	-	3
basalt	1	1	-	1	-	-	3
chert	1	-	-	-	2	-	3
concretion	1	7	9	-	-	-	17
diabase	-	-	-	-	1	-	1
diorite	-	3	5	-	-	-	8
gneiss	-	3	5	-	4	1	13
granite	14	47	35	-	11	8	115
greywacke	-	-	4	-	-	-	4
limestone	1	4	1	1	-	2	9
mudstone	11	9	11	-	-	-	31
quartzite	1	3	3	1	-	-	8
quartz	-	2	-	-	-	-	2
shale	-	10	-	3	-	-	13
schist	-	2	-	-	-	-	2
sandstone	1	13	4	-	1	2	21
silicified sediment	-	6	-	2	-	-	8
unidentified	5	9	38	-	8	10	70
Total	37	127	117	8	27	23	339
Weight							
amphibolite	5	81	-	-	-	-	86
andesite	-	*	8	-	-	-	8
basalt	11	455	-	2	-	-	468
chert	2	-	-	-	3	-	5
concretion	*	46	138	-	-	-	184
diabase	-	-	-	-	249	-	249
diorite	-	7	6	-	-	-	13
gneiss	-	2	448	-	1,357	2	1,809
granite	71	473	214	-	311	70	1,139
greywacke	-	-	254	-	-	-	254
limestone	*	276	112	1	-	4	393
mudstone	4	7	8	-	-	-	19
quartzite	1	21	295	4	-	-	321
quartz	-	6	-	-	-	-	6
shale	-	3	-	5	-	-	8
schist	-	440	-	-	-	-	440
sandstone	41	105	23	-	21	619	809
silicified sediment	-	3	-	16	-	-	19
unidentified	960	2,798	5,979	-	315	295	10,347
Total	1,095	4,723	7,485	28	2,256	990	16,577

byproducts of stone-boiling. It is surprising how much of this residue wound up on the floor of the activity area and how little was in the hearths. One wonders if most of the rock fracturing and discard took place in the use area, not at the heating site(s). A small residue of fine-grained unmodified or naturally fractured pebble fragments were probably natural constituents of the soil.

Table 8.3. Layer III potsherds by vessel and excavation unit.

Sherds	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
vessel B	-	-	3	-	-	-	3
vessel C	-	2	-	-	-	-	2
vessel D	-	-	7	-	-	-	7
unclassified	1	-	-	-	-	-	1
Total	1	2	10	0	0	0	13
Weight							
vessel B	-	-	1.7	-	-	-	1.7
vessel C	-	0.5	-	-	-	-	0.5
vessel D	-	-	3.4	-	-	-	3.4
unclassified	0.5	-	-	-	-	-	0.5
Total	0.5	0.5	5.1	0.0	0.0	0.0	6.1

Pottery

We discovered 13 pieces of pottery during excavation of Layer III (Table 8.3), but at least 12 and probably all 13 pieces were intrusive from layers above and below. Five sherds from vessels B and C of Layer II were found at the top of Layer III. Vessel B was represented by three body sherds weighing 1.7 g, all in XU 3 directly below the main concentration of vessel B sherds in Layer II. Vessel C was represented by one body sherd and one crumb weighing 0.5 g. These were in XUs 1 and 2, conforming to the Layer II distribution for the same vessel. A combination of trampling, rodent burrowing and Sjovold test pitting may have been responsible for the downward migration of these sherds. Meanwhile, Layer III also included seven sherds of a 7 mm thick vessel with a polished smooth exterior marked by shallow 1 cm wide flutes or grooves and a greyish brown exterior colour (10YR 5/2). Its slightly laminated and granular paste is quite hard, dark grey to black, and contains crushed, burned orange, granite temper. Its interior surface is smooth, almost polished, and very dark grey (7.5YR 3/0). Though the sample is small, it seems identical to sherds from a spiral-grooved Avonlea vessel (vessel D) situated in Layer VI directly below. These seven sherds could have been transported up to Layer III via animal burrows. Casts of three burrows up to 15 cm diameter were situated in XU 3 and penetrated Layer III, Layer IV-V and Interlayer V/VI. This leaves only one unclassified sherd for Layer III still unaccounted for. It is part of a thin (4 mm) smooth (exterior and interior) greyish brown (10YR 5/2) vessel. Although not identical, it is very similar to sherds of vessel C from Layer II. The Layer III crumb was situated in XU 1 which also produced vessel C sherds in Layer II. If the single unclassified sherd is also intrusive, then Layer III occupation remains are aceramic.

Stone Tools

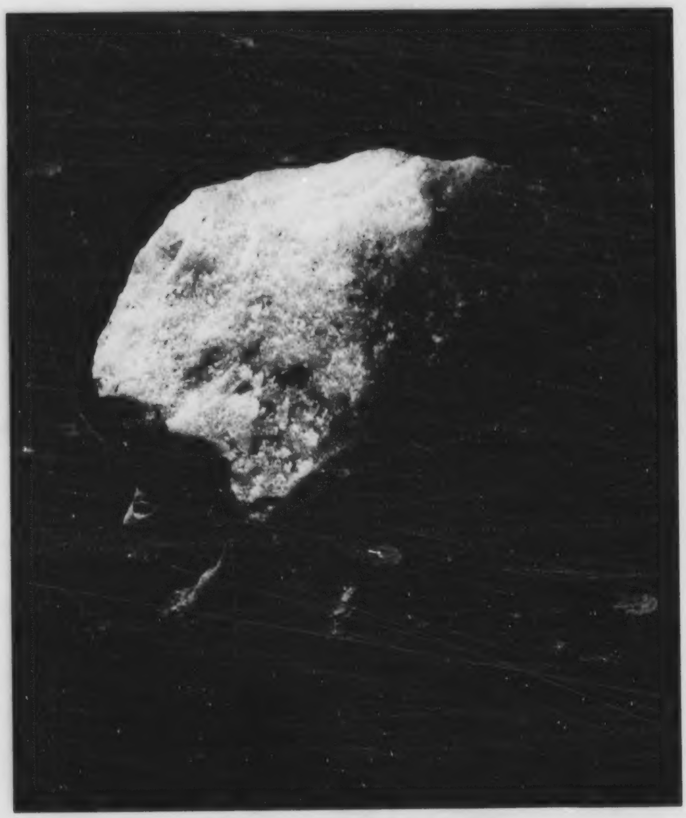


Figure 8.4. Chipped stone axe from Layer III. (EiNs-4:2098).

Chipped Stone Axe (n=1). Catno 2098 is a crude, sharp-edged biface made on a hefty spall of light grey quartzite (see Fig. 8.4). A bifacially chipped edge runs continuously down one side, across one end and up the other side. The remaining end forms a broad butt roughly perpendicular to the plane of the tool as defined by the bifacial edges. The butt end has three large "facets," one of which is a 40x32 mm area of original cobble cortex. About 4 cm down each side from the butt is a large notch where the edge is not only indented but very smooth, apparently due to crushing. The notches vary from 25-40 mm in breadth to 8-13 mm in depth. The distance straight across the tool between the notches is about 80 mm, but that increases to about 120 mm when measured across the surface. If a handle was hafted to this tool, then it would have had to contend with a thickness of 55 mm and a somewhat irregular hafting surface. However, a split willow wand looped over the haft area and bound together with damp rawhide in traditional Plains Indian fashion (cf. Wissler 1934:29; Orchard 1942:37, 39, 44) could easily have been attached to this haft. Another possibility is that the tool was hand held. When gripped in one hand with the proximal phalanx of the thumb in one notch and the distal phalanges of the two central fingers in the other, the sharp bifacial end of this tool protrudes about 15 to 25 mm beyond the fourth finger or edge of the hand. That might be workable for some jobs, but it would be a bit too close for many others. Our guess is that this axe head was hafted.

Table 8.4. Stone tools from Layer III.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
axe	2098	5	780.9	110	104	60	quartzite	y	8.4
chipping hammer	695	3	131.0	57	38	38	andesite	y	8.5c
chipping hammer	827	3	193.1	78	45	38	syenite	y	8.5d
chipping hammer	2094	5	147.5	55	46	33	sandstone	y	8.5b
chipping hammer	2096	5	101.6	58	39	30	andesite	y	8.5a
chitho	2088	5	585.7	177	160	14	schist	y	8.6
chitho?	651	2	16.1	38	33	10	sandstone	n	-
endscraper	528	2	2.6	29	17	6	agate	y	8.7j
endscraper	765	2	11.6	40	31	8	Swan River Chert	y	8.7k
endscraper	2076	4	2.6	27	24	5	silic. sediment	y	8.7l
MURL	533	2	1.2	20	17	4	chert	y	8.7d
MURL	535	2	0.9	18	14	3	chert	y	8.7c
MURL	726	2	1.1	23	11	6	chert	n	8.7f
MURL	754	3	0.5	18	13	3	fused shale	n	8.7b
MURL	825	3	3.1	41	13	6	petrified peat	?	8.7e
MURL	2195	6	1.8	23	16	7	petrified peat	n	8.7a
preform	36	*0	0.7	14	15	3	petrified wood	n	8.7g
projectile point	853	2	1.0	25	14	3	chert	y	8.7i
projectile point	2122	5	0.3	12	9	3	Swan River Chert	n	8.7h

* found on the south edge of XU 5 in Test Profile No. 2.

Chipped stone axes are rare but not unknown in the northern Plains. Wettlaufer (1951) found several of them during his 1951 survey of southern Saskatchewan archaeological collections. Examples occurred at the Preston Avenue site, Wettlaufer's S-15 or FaNp-2, just south of Saskatoon (ibid.: 23; subsequent investigations by Rollans and McKeand [1992] and Meyer and Clarke [1991, 1992; Clarke and Meyer (1993)] have shown this locality to contain Moose Jaw, Prairie Side-notched and Avonlea components); in the Frenchman Butte area (ibid.: 44); the Eight Mile Lake site, S-43 or FeOc-1, near Battleford (ibid.: 44); the Vanscoy, Biggar, Fielding and Battlefords areas (ibid.: 47, 48); the Mortlach area (ibid.: 56); and Stoney Beach Midden, S-73 or EdNh-1 (ibid.: 68). More recently Walker (1990:39-40) found a similar specimen made of grey quartzite on the surface of DhNe-19, near the Saskatchewan-Montana border. The only dated specimen known to us occurred in the Crown Site, FhNa-86, near Nipawin (Quigg 1986:189, Fig.7.15). FhNa-86 is a small riverside campsite dating to about AD 925-1400 (two ^{14}C dates calibrated in calendrical years). In addition to a chipped stone axe (there classified as a hafted chopper), the occupation included small side-notched projectile points, a surface hearth, a good deal of fire-broken rock, pottery attributed to both Laurel and Avonlea styles, and other occupation debris. The site is attributed to the Laurel complex with the proviso that there appears to be some inclusion of Avonlea ceramic traits.

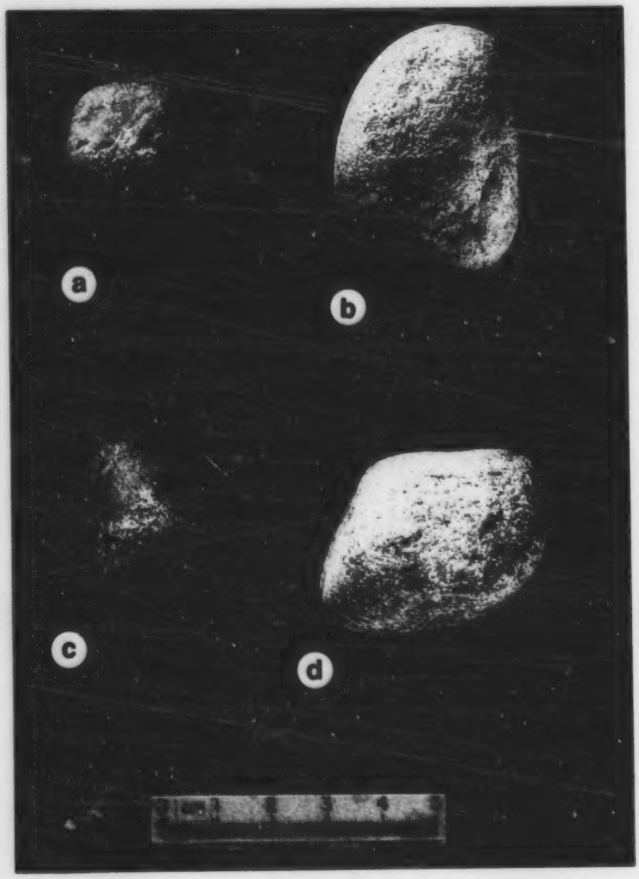


Figure 8.5. Chipping hammers from Layer III.

Chipping Hammers (n=4). Four hard pebbles with crushed and pitted areas on the ends were found in Layer III (Fig. 8.5; Table 8.4). The pitting/crushing is concentrated in small elongate patches whose areas range from 108-900 mm^2 and whose depths are seldom more than 1-2 mm. The number of such areas per specimen varies from 1 to 3, and they are always situated at an end position. One of the pebbles (catno 2094) has a finger-wide smear of a glossy black substance across its flattest (ventral) surface. We have not been able to establish the constituents of the smear. The pebbles were found in XUs 3 and 5 on the peripheries of a concentration of stone chipping debris found mainly in XUs 2 and 3. The nature of the pitted areas and the provenience of the pebbles are consistent with use as chipping hammers for reduction of chipable stone by direct percussion. The modest weights suggest that these chipping hammers would have been effective on jobs such as opening up small masses of raw material, making blanks or preforms into tools and rejuvenating worn or damaged edges. A good comparative sample is the 24 pebble hammerstones recovered in the Late Prehistoric level of the Crown site (Quigg 1986:184-187). The four Sjovold specimens show many similar characteristics — raw materials, shapes, sizes and locations of pitted/crushed areas, and number of such areas per specimen. The Sjovold chipping hammers are within but near the small end of the Crown site size range. A clear difference is that none of the Sjovold specimens has a pitted/crushed zone in the midst of a large flat face, an attribute that Quigg interpreted as indicating use as an anvil.

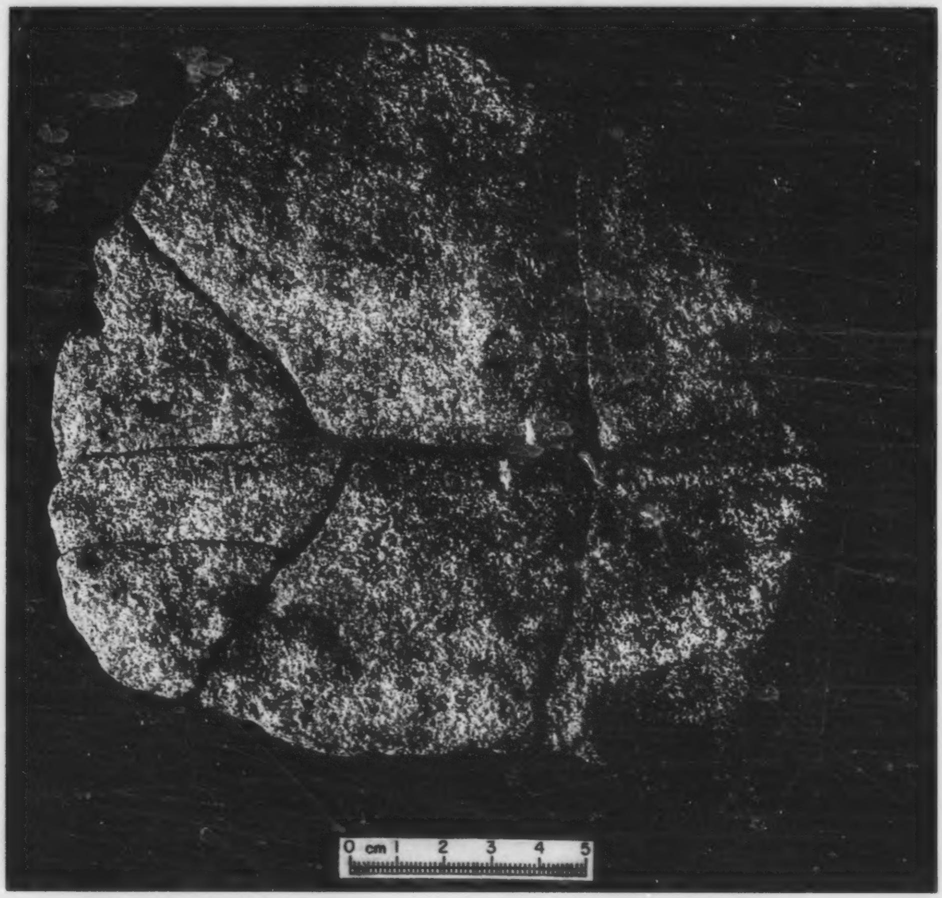


Figure 8.6. Chitho from Layer III.

Chithos (n=2). Another unusual find is a large schist disk with a completely encircling bifacially chipped edge (catno 2088). This tool was found in six pieces like a smashed plate (see Fig.

8.6 for the reassembled too'). The sides are quite thin and sharp, while the ends are dull and rounded. A red stain or residue is found over most of both faces, but is almost completely absent on primary flake scars near the margins and on the edge itself. Indeed, flake scars originating on the edge have a fresh look, and the edge may have been sharpened shortly before the tool was broken and discarded. The stain or residue consists of tiny reddish granules and of yellowish-red "staining" or interstitial penetration of quartz grains. An RCMP serologist examined similar stains/adhesions on other specimens from this site and declared that they looked similar to the haemoglobin portion of blood residue. However, preliminary chemical tests failed to confirm such an identification. Other possibilities are hematite staining or adhesion, or heat-alteration of the surface minerals.

A triangular piece broken from a fairly large fine grained sandstone tool may be part of a second chitho (catno 651). This fragment is light buff and speckled brown. Its dorsal and ventral surfaces are roughly flat. Two sides exhibit shear vertical planes of breakage, but the third has a gently curving unifacially chipped edge that appears to have been moderately rounded by wear. Under magnification it is apparent that the brown speckling is due to minute adhesions of a yellowish brown substance. Occasional small specks, minute clusters of granular reddish material, may also be seen. Overall, the residue on this specimen is much sparser than that on catno 2088.

Objects of this kind are common in the subarctic region of North America (cf. Gordon 1976; Wright 1981; Clark 1987) where they are known by the name "chitho" and ascribed to the function of women's hide working tools. Recently, Pokotylo and Hanks (1989) found that a similar tool known as a "tthete" is still being made by Slavey Indians of the Mackenzie River Valley. The tthete is made and hafted by men, and used by women as a hide softening or graining tool. The distribution of such tools is very broad in subarctic contexts including, Taltheilei (Athapaskan), Pre-Dorset (Paleoeskimo), Shield Archaic, and Woodland manifestations such as Laurel (cf. Stoltman 1973: Plate 36) and Blackduck. However, to our knowledge, chithos are less common in prairie contexts. In his survey of Saskatchewan collections, Wettlaufer (1951:39) recorded notched mica schist "hoes" from sites S-35 (EkNr-1) and S-36 near Donovan. These may be variants of the type. Later, Wettlaufer (1955) found more closely comparable tools in the Mortlach site: a broken mica schist "stone plate" in the Moose Jaw cultural level (ibid.: 31, Plate 3, No. 18); and an oval "hoe-like scraper" of mica schist in the Mortlach cultural level (ibid.: 22, Plate 1, No. 9). There are also four chithos in the Canadian Museum of Civilization collection from the Lake Midden site, EfNg-1 (CMC catnos. XB-363, 432, 547 and 548). Investigations by Watrall (1979) have shown that EfNg-1 is a fall-winter-spring bison hunters' habitation site dating to between A.D. 1000-1500; Malainey (1991) has identified the ceramics as being Wascana Ware and the complex as Moose Jaw.

Endscrapers (n=3). Three endscrapers (see Fig. 8.7) are made on two expanding flakes and one indeterminate flake. None shows any lateral edge or dorsal chipping, and all possess at least part of the raw material cortex. Thus, aside from the unifacially chipped working end, all three are products of very minimal preparation. Nevertheless, the base flake was probably chosen quite deliberately. The materials are among the best in the level, two pieces being microcrystalline and quite

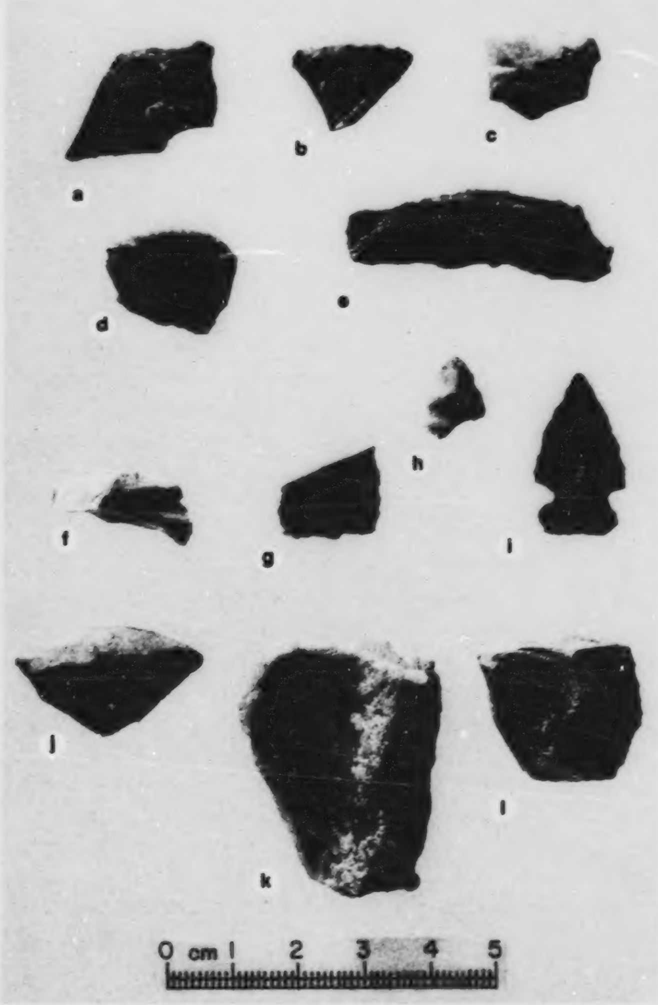


Figure 8.7. Stone tools from Layer III. a-f, MURLs; g, preform; h-i, projectile points; j-l, end scrapers.

homogeneous, the other, made of Swan River Chert, being reasonably fine-grained. In all three cases the ventral surface is dished so that the working edge is slightly beaked and would always remain that way, even after resharpening. Failed attempts at resharpening, however, seem to have been the reason these endscrapers were discarded. Catno 2076 exhibits a series of fresh but very short chip scars about three quarters of the way across the working edge; catno 765 has fresh short scars ending in hinge fractures along about one third of its edge; and catno 528 has a whole freshly chipped edge, but the middle section of its dorsal surface and a substantial portion of its bulk has been lost due to the removal of one overshot sharpening flake, a flake we recovered and refitted. One of the endscrapers was piece-plotted at a position about 50 cm west of hearth F3-c; the others, from screenings in XUs 2 and 4, could also have been associated with the peripheries of that hearth.

MURLs (n=6). The residual nature of the MURL category is quite evident when one sees the variety of retouched edges for Layer III. Catnos 533 and 535 exhibit fine unifacial retouch along one lateral edge of a thin expanding flake. Like a similar specimen (catno 437) from Layer II, these were probably used for fine cutting. Catno 825 is an elongate piece of shatter with a gently curved edge about 25 mm of which exhibits very fine retouch. The edge angle is about 45 degrees, which is steep enough for use as a scraper, yet shallow enough to be a cutting tool. Catno 2195 is a 16 mm long segment of an apparently bifacially retouched edge, possibly a piece of a medium-size biface knife. Catno 754 is a 19 mm segment of a thin bifacial tool, probably a projectile point. Catno 726, a small broken item with a bifacially chipped or crushed end may be part of a bipolar core.

Projectile point preform (n=1). Catno 36 is the basal third of a roughly triangular, bifacially chipped piece of arrowhead size. Its basal edge is slightly irregular as a result of bifacial chipping, but it is essentially straight. The sides are gently convex and, although truncated by a diagonal fracture, appear to be converging toward a point. There are no notches on the sides and no rounding or smoothing of any edges. The fracture surface along which the tip was detached is perpendicular to the plane of the faces and parallel to natural banding planes within the material. There is some salt-and-pepper coloured residue in the crevices of both faces which has the appearance of charcoal particles in a matrix of calcium carbonate and/or ash. There are also areas of orange discolouration on each face, further indication that the piece has been in contact with fire.

Projectile points (n=2). We recovered one small side-notched projectile point (catno 853) broken into two matching pieces from hearth F3-a, and the tip of another small biface (catno 2122), presumably a point, in XU 5. The side-notched point (see Fig. 8.7) is bifacially retouched and has flake scars over the whole of both faces. The notches are shaped like rounded "v's" and commence about 2.5 mm above the base. The basal edge is flat but points of juncture at each end make obtuse angles with the lateral edges giving the corners a rounded effect. All the edges are sharp, as is the point on the tip. The fracture which divides this projectile point into two pieces extends from the middle of one notch to the lateral edge just 2 mm above the other notch. Some 13 flakes of the same stone material (catno 844) were found in the hearth with the point. Thus, it appears that the point was broken during manufacture, probably while notches were being added. Then, along with the manufacturing residue, it was discarded into the hearth. Application of the Thomas (1978) discrimination equations for arrowheads and darts to catno 853 yields values of $C_{dart} = 3.49$ and $C_{arrow} = 5.84$. This confirms what appears to be obvious - that the point was intended for use as an arrowhead. As to type, it falls between Prairie Side-Notched and Plains Side-Notched of the Late Side-Notched series (Dyck 1983). Its notches are a little higher on the lateral edges than most Prairie Side-notched points and its corners are not so square as most Plains Side-Notched points. The point compares fairly closely to one from the Late Prehistoric layer at the Crown site (Quigg 1986: Fig. 7.8, #4). There are also similarities to Terminal Woodland types such as Laurel (Wright 1967: Plate 4, #1-2), Blackduck and Selkirk (Buchner 1979). Consequently, beyond being side-notched and Late Prehistoric, the projectile point does not seem to be diagnostic for a particular complex.

Chipped Stone Debris

The predominant chipping materials by weight (Table 8.5) are quartzite (37.1 %), petrified peat

Table 8.5. Chipped stone debris, excluding cores, from Layer III.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
agate	2	3	-	-	-	-	5
andesite	-	2	1	-	-	-	3
basalt	-	-	1	-	-	-	1
chert	6	56	22	-	4	7	95
chalcedony	-	-	1	-	-	-	1
fused shale	-	-	1	-	-	-	1
Gronlid Siltstone	2	45	16	-	-	8	71
petrified peat	6	347	71	3	6	9	442
petrified wood	1	18	43	-	2	-	64
quartzite	2	122	43	1	8	53	229
quartz	-	-	2	-	3	1	6
sandstone	-	1	5	-	-	-	6
Swan River Chert	5	131	302	1	26	27	492
silicified sediment	9	9	-	2	3	1	24
unidentified	-	2	2	-	-	-	4
Total	33	736	510	7	52	106	1,444
Weight							
agate	0.8	12.5	-	-	-	-	13.3
andesite	-	0.3	0.2	-	-	-	0.5
basalt	-	-	10.3	-	-	-	10.3
chert	5.5	42.0	46.2	-	4.3	15.3	113.3
chalcedony	-	-	2.2	-	-	-	2.2
fused shale	-	-	<0.1	-	-	-	<0.1
Gronlid Siltstone	3.1	40.7	47.5	-	-	10.1	101.4
petrified peat	86.0	337.0	67.6	11.3	23.7	9.7	535.3
petrified wood	13.7	17.0	31.3	-	15.6	-	77.6
quartzite	1.5	52.3	230.9	7.0	155.6	247.6	694.9
quartz	-	-	35.7	-	4.2	0.3	40.2
sandstone	-	0.2	2.3	-	-	-	2.5
Swan River Chert	33.1	52.0	72.9	1.3	40.9	38.8	239.0
silicified sediment	7.1	21.5	-	2.8	3.8	3.5	38.7
unidentified	-	0.2	1.1	-	-	-	1.3
Total	150.8	575.7	548.2	22.4	248.1	325.3	1,870.5

(28.6%), Swan River Chert (12.7%), chert (6.0%), and Gronlid Siltstone (5.4%). An indication of the coarseness or fineness of chipping attempted on various Layer III materials can seen by calculating the average weight of specimens by material type — the smaller the average weight, the finer the chipping. Accordingly, quartzite (3.03 grams per specimen) was subject to coarser chipping; Gronlid Siltstone (1.42), petrified peat (1.21), petrified wood (1.21), and chert (1.19) to medium chipping; and

Table 8.6. Chipped stone cores from Layer III.

Type	Catno	XU	Weight	Size*	Material
amorphous	830	3	197.6	c	sandstone
biface	2169, 2170	6	33.7	c	Gronlid Siltstone
bipolar	710	1	5.0	b	jasper
bipolar	755	3	4.4	b	petrified wood
bipolar	852	2	6.5	b	petrified peat
bipolar	851	2	6.2	b	chert
simple	802	2	9.0	b	chert
simple	594	1	97.5	c	chert
spall	2162	6	406.7	d	quartzite

* size refers to categories based on greatest length: (a) 13-25mm, (b) 26-49 mm, (c) 50-100 mm, (d) 100-149 mm, and (e) 150 mm and larger.

Swan River Chert (0.48) was used for fine chipping.

When one compares chipping debris to chipped stone tools it is apparent that the lone quartzite tool, the axe made of light grey material, does not match the predominantly rusty mauve and tan quartzite chipping debris found in the site. This tool may have been carried to the site in its present state. Conversely, whatever quartzite tools were made at the site may have been carried away. Petrified peat, petrified wood and chert are well represented both in debris and also in the MURL tool category. Chert also appears in the projectile point tool category. Swan River Chert appears in two tool types, endscrapers and projectile points, confirming that some of those items were being made at the site, and that they are end products of the finest chipping. Gronlid Siltstone, a substantial part of the debris, was not represented among recovered tools.

Several kinds of core technology were used in Layer III, since amorphous, bifacial, bipolar, simple and spall cores are all present (see Figs. 8.8, 8.9; Table 8.6). One of the smaller bipolar cores, catno 755, also has attributes of a tool type referred to as wedges (cf. Gordon 1976:215-219) or pièces equillées (cf. MacDonald 1968; Magne 1985:161, 168; LeBlanc 1992). Five cores are in the small size range (25-49 mm). Three are in the 50-99 mm range, and only one is in the 100-149 mm range. The average core weight is 85.2 g. The shares (by weight) held by various materials are quartzite (53.5%), sandstone (25.8%), chert (14.7%), Gronlid Siltstone (4.4%), petrified peat (0.8%), jasper (0.7%) and petrified wood (0.6%). Thus, there is a fair degree of correspondence between the proportions of stone materials represented by cores and by other chipping debris. Quartzite is dominant in both, and chert, Gronlid Siltstone, petrified wood and sandstone are present in both. There is also a high degree of overlap in the material types of Layer III stone tools and chipped stone cores indicating that many of the tools discarded at the site were likely made there. The proveniences of cores, other debris and stone tools likewise show a positive correlation with one another. XUs 2-3, for example, contained 55% of the cores, 50% of the pecking hammers and 86.3% of other chipping debris (all by number)

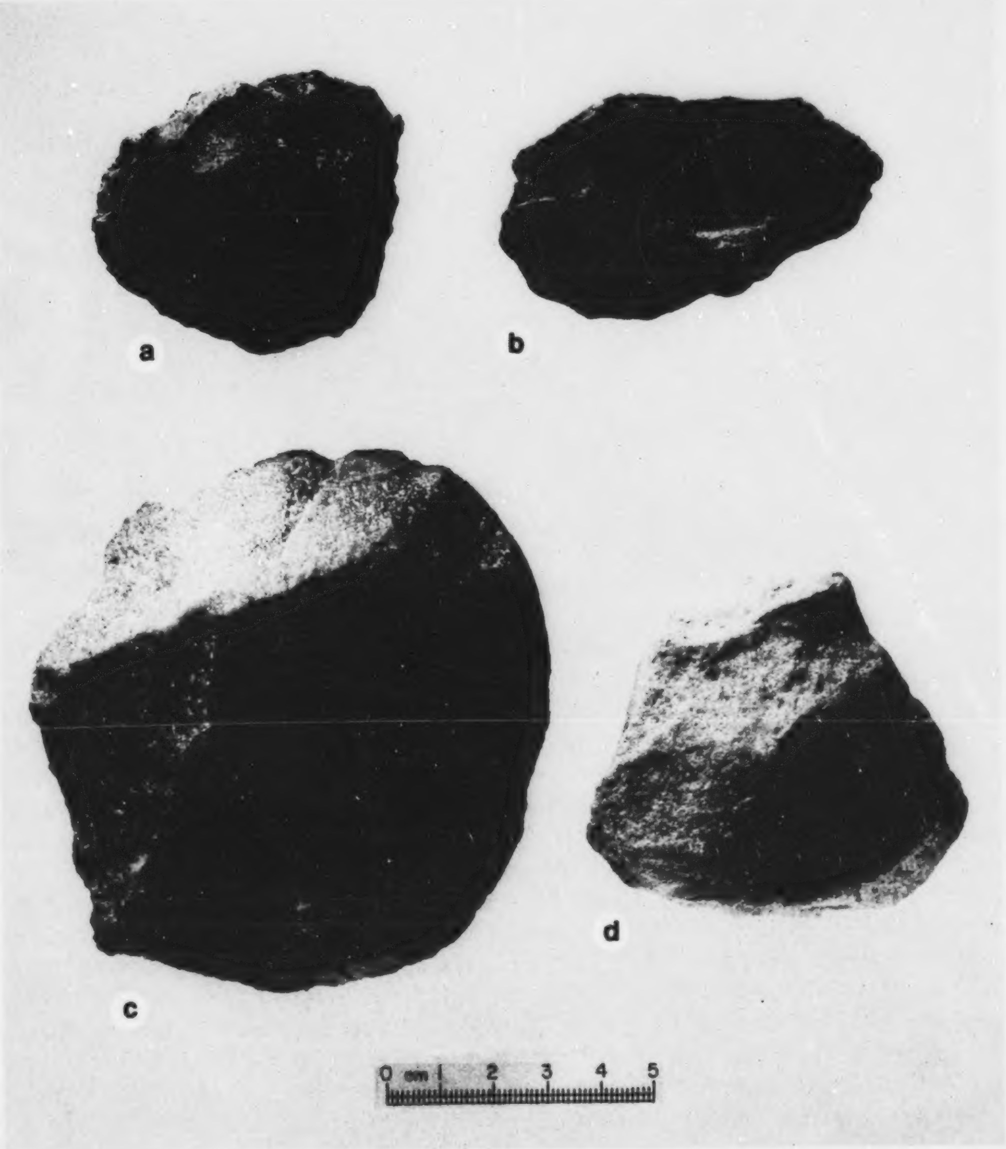

a
b
c
d
0 cm 1 2 3 4 5

Figure 8.8. Large chipped stone cores from Layer III.
a, EiNs-4:594; b, 2169+2170; c, 2162; d, 830.

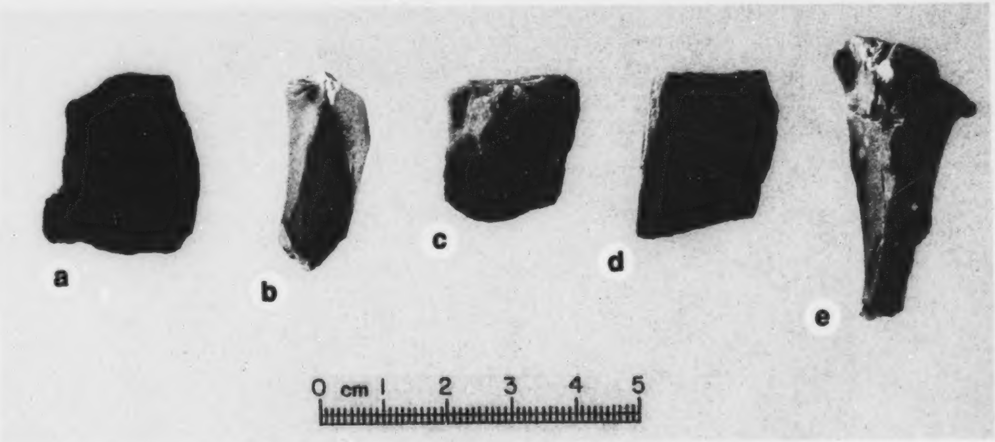


Figure 8.9. Small chipped stone cores from Layer III.
a, EiNs-4:851; b, 710; c, 755; d, 852; e, 802.

indicating common areas for disposal and probably also for use of these kinds of artifacts.

There are three possible sources for the quartzite: local undifferentiated quartzite (Dyck 1990); Athabaska Quartzite from primary sources in the Canadian Shield and from drift sources in central Saskatchewan (Johnson 1986); and Rocky Mountain Quartzite from Tertiary deposits in southwestern Saskatchewan (Johnson 1986). Colour has been found to be of some value in differentiating types of quartzite (Johnson 1986), but it is not too useful for Layer III since heat may have altered many of the specimens (46 rusty mauve pieces) and because the next most prominent colour (25 gold/yellow/tan pieces) is found in both types. Thus, the sources of the quartzites have not been determined. After quartzite, the next most common Layer III material is petrified peat. It is probably of local Saskatchewan River Valley origin since our crew found quantities of this material in pebble size slabs along the river flats, especially opposite the Town of Outlook just a few km north of the site. Johnson (1986) suspects that there is a primary source of petrified (silicified) peat near Wood Mountain in south-central Saskatchewan, but he notes that deposits of it have also been found in the Birsay-Macrorie region just south of the Sjovold site, as well as on the shore of Lake Diefenbaker and farther south in the Rock Glen area. Swan River Chert is a predominant chipping material in east-central Saskatchewan (Johnson 1986), but it is also found as raw material and worked tools throughout southern Saskatchewan. The prominence (12.7%) of Swan River Chert at this site is a bit higher than might be expected from its local availability, leading us to suggest that Sjovold Layer III inhabitants may have had some sort of affinity toward east-central Saskatchewan. The same conclusion arises from the presence of Gronlid Siltstone whose sources are thought to lie along the North Saskatchewan River in east-central Saskatchewan (Johnson 1986).

Overall, the chipping materials used at Sjovold Layer III make an interesting comparison with

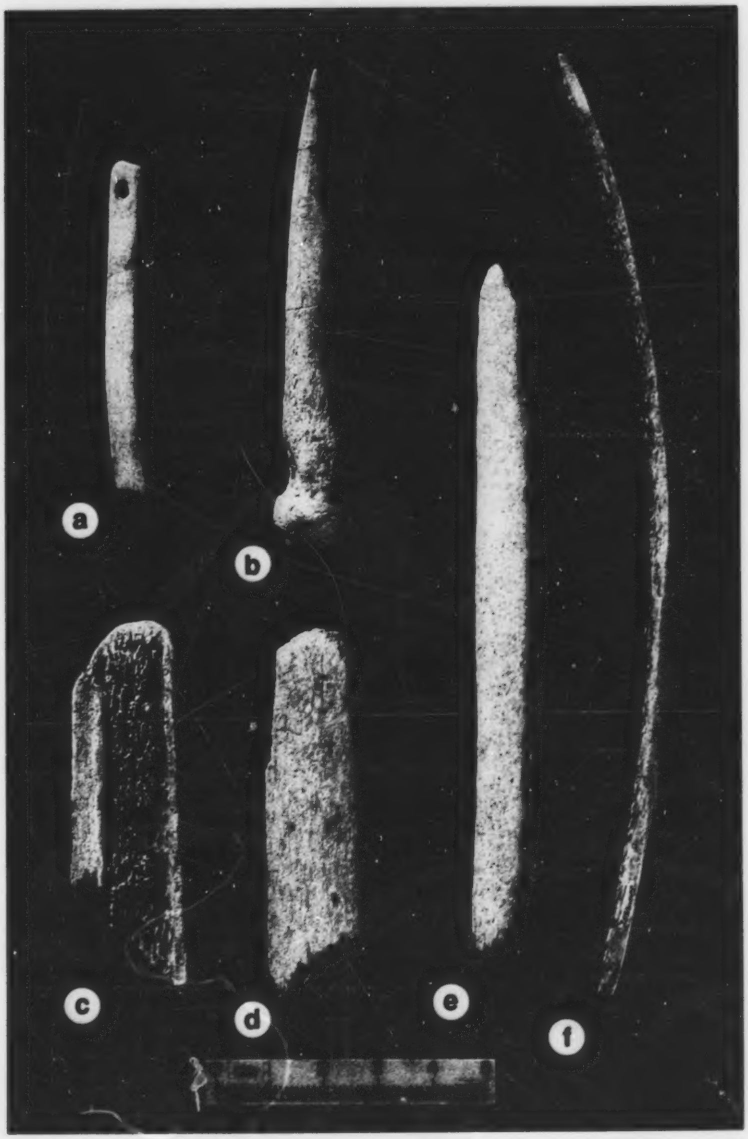


Figure 8.10. Bone tools from Layer III. a, needle? (EiNs-4:702); b, moose bone awl (756); c-d, flakers (595,2142); e-f, awls (738,552).

those found at the contemporary Crown site situated some 280 km to the northeast at a position much closer to abundant sources of Swan River Chert. Some 5788 pieces of chipping debris were recovered at the Crown site representing 22 different material types. However 3 materials were quite dominant by weight (Quigg 1986:170): Swan River Chert (64.0%), quartzite (20.3%), and quartz (7.5%). At the Crown site the average weights of debitage of these materials (apparently exclusive of cores) were: quartzite (5.80 grams per specimen), quartz (4.98), and Swan River Chert (3.51). One sees a somewhat similar sequence of numbers with quartzite (supplemented by quartz at the Crown site) being the coarsest chipping material at both sites, but at the Crown site the Swan River Chert debris spans the whole gambit from coarse to fine (Quigg's analysis shows an even representation of SRC flakes and shatter in primary, secondary and tertiary stages of flaking). There is also a marked distinction between the Sjovold and Crown sites in the greater magnitude of the Crown site average weights. That is probably indicative of the fact that the Crown site lies within a rich (chipping) stone area while the sources of chipping materials available at the Sjovold site are certainly sparser and somewhat poorer.

Bone Tools

Layer III is unusually rich in bone tools, including three pressure flakers, three awls, and a possible needle (see Fig. 8.10). The three pressure flakers, two from XU 1 (catnos 595, 652) and one from XU 5 (catno 2142), are made on large mammal ribs. Two of them are similar in length, measuring 67 mm and 68 mm respectively, after fracturing while still fresh, presumably during use. The third is a small fragment only 29 mm long. All the working tips have rounded outlines in lateral view, while their sectional views reveal two rounded profiles and one beveled toward the lateral surface.

Two awls are made on large mammal ribs from XU 2 (catno 552) and XU 3 (catno 738). Catno 552 is 172 mm long and exhibits both longitudinal and transverse striations on an abruptly constricted tip, 12 mm long, shaped by scraping. The opposite end of this tool is highly polished for a distance of 37 mm from the tip of a pointed fracture surface that was not deliberately shaped. Catno 738 is 126 mm long with a 12 mm abruptly constricted, polished tip shaped by scraping and exhibiting transverse striations. It is possible that these abruptly constricted tips were designed to gauge the depth of penetration. The delicate transverse striations near the tips match experimentally induced striations attributed to contact with hair on a fresh hide (Lemoine 1989:213, Fig. 7). The third awl, from XU 1 (catno 756), is made on the accessory metapodial (splint bone) of a moose. At 89 mm in length, more than half of the bone has been removed by manufacture and/or use, but there is no apparent polish. The tip exhibits longitudinal striations and bidirectional damage from use in perforation. Stoltman (1973: Pl. 44d) illustrates a similar specimen from a Laurel context.

The possible needle is made on an unclassifiable large mammal bone fragment from XU 3 (catno 702). This is a slender sliver of bone with a hole near one end. The other end is broken and covered with glue as if an additional piece had originally been fitted where the tip should be. If the

Table 8.7. Vertebrate remains from Layer III.[a]

Size, Taxon	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
6, Bison	6	3	6	2	11	9	37
6, Moose	1	-	-	-	-	-	1
5-6, mammal	28	28	32	8	124	26	246
5, Deer or Pronghorn	-	-	1	-	1	-	2
5, Deer	-	-	-	-	2	-	2
5, Dog?	-	1	-	-	-	2	3
4, Porcupine	-	-	-	-	1	-	1
4, Badger	-	-	2	-	-	-	2
4, Otter?	-	-	-	-	-	1	1
3, Rabbit or Hare	2	2	-	-	-	-	4
3, Cottontail	-	-	-	2	-	-	2
3, Jackrabbit	-	-	1	-	-	-	1
3, Marten or Fisher	-	-	1	-	-	-	1
3, mammal	-	1	4	-	1	-	6
2, Ground squirrel	*12	-	-	-	-	-	12
1, Red-backed vole	*1	-	-	-	-	-	1
-, mammal	122	580	164	59	167	156	1,248
Total	172	615	211	71	307	194	1,570
Weight							
6, Bison	280.0	126.5	302.2	53.2	154.2	334.2	1,250.3
6, Moose	3.5	-	-	-	-	-	3.5
5-6, mammal	221.1	71.4	100.0	48.3	144.1	85.1	670.0
5, Deer or Pronghorn	-	-	13.1	-	3.2	-	16.3
5, Deer	-	-	-	-	9.6	-	9.6
5, Dog?	-	0.1	-	-	-	28.8	28.9
4, Porcupine	-	-	-	-	2.8	-	2.8
4, Badger	-	-	6.4	-	-	-	6.4
4, Otter?	-	-	-	-	-	0.1	0.1
3, Rabbit or Hare	0.4	1.6	-	-	-	-	2.0
3, Cottontail	-	-	-	0.4	-	-	0.4
3, Jackrabbit	-	-	0.2	-	-	-	0.2
3, Marten or Fisher	-	-	0.3	-	-	-	0.3
3, mammal	-	0.3	2.1	-	0.4	-	2.8
2, Ground squirrel	1.3	-	-	-	-	-	1.3
1, Red-backed vole	0.1	-	-	-	-	-	0.1
-, mammal	78.7	158.5	84.1	26.0	77.0	86.1	510.4
Total	585.1	358.4	508.4	127.9	391.3	534.3	2,505.4

a. Superscripts (*) signify that these elements are thought to be intrusive into this layer.

tip tapered to a point, then it is reasonable to refer to this specimen as an eyed needle. As it stands, this artifact is most similar to the "dangler" reported by Forbis (1960:156, Pl. 5, no. 14) from Grassy Lake Cairn; however, the Sjovold specimen lacks the remnant cancellous tissue mentioned by Forbis. The bone has been worked by scraping, and possibly by grinding, to a thin rectangle measuring 63 x 5.9 x 1.8 mm. Longitudinal striations and chatter-marks are faintly visible locally but have been generally obscured, possibly by grinding. Centered 5.4 mm from one end is an oval hole, 2.9 x 2.0 mm, biconically grooved and drilled. The end near the hole is rounded, very smooth, and slightly polished. If this tool served as a needle, it might have been used to stitch hides or to form netting.

Faunal Remains

Layer III yielded an unusually diverse faunal assemblage (Tables 8.7, 8.8). A radiocarbon sample (S-1759) consumed approximately 250 g of bone from XUs 1-3, including the talus shown in Figure 8.1 (TAL).

Bison, NISP=37: four upper teeth (P^3, P^4, M^1, M^2; AG 7), two lower teeth (M_2, M_3; AG 4?), unworn lower molar ©, two thoracic neural spines, two lumbar transverse spines, nine ribs, two humerus shafts, a distal radioulna epiphysis ©, distal radius shaft ©, carpal 2+3 ♀/©, front 1st phalanx ♂, four calcanei ♀♀ ♀/© ©, tarsal C+4 ♀/©, tarsal 2+3 ♀/©, tarsal 1, proximal metatarsal, two distal metatarsals ♀♀, first phalanx. The "calf" elements are not all of the same age. For example, the unfused distal radioulna epiphysis and one calcaneus could be as old as four years if a bull or five years if a cow. Another calcaneus is the smallest in the site and represents a calf that could also have produced the unworn molar and the distal radius shaft. A very young calf, probably less than 2 years old, is represented by a humerus shaft cylinder that has a porous surface and is weathered to Stage 2. Hence, these 37 bones and teeth represent portions of five bison age/gender groups: adult bull (MAU=0.25), adult cow (MAU=1.0), and calves of three ages (each MAU=0.5).

Sixteen bison bones were fractured when fresh, and five exhibit cut marks (Table 8.8). Both of the thoracic neural spines bear multiple incisions that may reflect removal of hump meat, and multiple marks on a rib and on a humerus shaft near the teres tuberosity likewise are probably filleting marks. The tuber calcis of one calcaneus is marked by multiple incisions that could have resulted from dismemberment. Tooth marks are present on eight specimens. Carnivore tooth punctures are seen on the humerus cylinder, the radioulna epiphysis, and three ribs, while one rib is furrowed by a carnivore near the proximal end. One calcaneus also exhibits carnivore tooth furrowing. The unworn molar fragment has been gnawed by a rodent. Eight bones are weathered to Stage 1, and only the more susceptible juvenile humerus cylinder is weathered to Stage 2.

Moose, NISP=1: accessory metapodial (splint bone), fashioned into an awl.

Size 5-6 mammal, unidentified, n=246: three cranial, one mandible, 147 tooth, 43 rib, one

Table 8.8. Modified vertebrate remains from Layer III.[a]

								Fracture States				
Size, Taxon	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	5	-	8	-	9	21	7	-	5	16	9	37
6, Moose	1	-	-	-	-	1	-	-	-	-	1	1
5-6, mammal	13	-	12	1	*	*	147	-	22	77	-	246
5, Deer or Pronghorn	-	-	2	-	-	2	-	-	-	2	-	2
5, Deer	-	-	1	-	-	2	-	-	-	2	-	2
5, Dog?	-	-	-	-	-	2	2	-	1	-	-	3
4, Porcupine	-	-	-	-	-	1	-	-	-	1	-	1
4, Badger	1	-	-	-	-	1	1	-	-	1	-	2
4, Otter?	-	-	-	1	-	-	1	-	-	-	-	1
3, Rabbit or Hare	-	-	-	1	-	-	-	-	1	2	1	4
3, Cottontail	-	-	-	-	-	-	-	-	-	-	2	2
3, Jackrabbit	-	-	-	-	-	-	-	-	-	1	-	1
3, Marten or Fisher	-	-	-	-	-	-	1	-	-	-	-	1
3, mammal	-	1	1	-	-	3	-	-	1	5	-	6
2, Ground squirrel	-	-	-	-	-	-	-	-	-	2	10	12
1, Red-backed vole	-	-	-	1	-	1	-	-	-	1	-	1
-, mammal	4	400	6	92	*	*	-	*	*	*	-	1,248

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

ulna, 51 long bone shaft fragments. Most (78%) of the bone fragments were fractured when fresh, and 13 exhibit cut marks. Of the latter, five are tools, and the others represent filleting from ribs and from the mandible fragment. Three rib and nine long bone fragments bear carnivore tooth punctures, and one long bone fragment exhibits evidence of digestion. Both cut-marked and tooth-marked fragments are scattered over the excavation area.

Deer or Pronghorn, NISP=2: metacarpal shaft, long bone shaft fragment. Both bones were fractured when fresh, and both have been gnawed by a carnivore.

Deer, NISP=2: radius shaft, femur shaft. Both were fractured when fresh, and the radius exhibits carnivore tooth punctures.

Dog?, NISP=3: I^3, M^2, innominate. Measurements of acetabulum length and ischium width place the innominate midway between our reference dogs (see Fig. 5.3), much larger than coyote and smaller than wolf. The teeth are too fragmentary to measure but subjectively are of appropriate size for a northern Plains dog.

Porcupine, NISP=1: tibia shaft.

Badger, NISP=2: M_1, proximal radius. The radius bears a cut mark on the shaft just below the head. Such a mark might result from either skinning or dismemberment.

Otter?, NISP=1: M^2. This tooth appears to have been decalcified, possibly by digestion.

Rabbit or Hare, NISP=4: mandible with P_3 alveolus, axis centrum, metacarpal II, proximal tibia. The metacarpal is very small and lacks its distal epiphysis. The axis centrum shows thinning due to digestion. The tibia was found at the southern edge of F3-a (Fig. 8.1).

Nuttall's Cottontail?, NISP=2: metatarsal III, metatarsal V.

White-tailed Jackrabbit, NISP=1: proximal radius.

Marten or Fisher, NISP=1: C_1.

Size 3 mammal, unidentified, n=6: one rib, five long bone shaft fragments. One long bone fragment is charred, and the rib fragment has been gnawed by a carnivore.

Ground squirrel, NISP=12: tympanic bulla, lumbar vertebra, two ribs, two humeri, distal humerus, ulna, innominate, acetabulum with ilium, acetabulum with ischium, tibia. The complete humeri and tibia lack proximal epiphyses, and the ulna is missing its distal epiphysis. The complete innominate represents an adult, but the other two innominate portions are not fused and represent a juvenile ground squirrel.

Gapper's Red-backed Vole, NISP=1: anterior portion of skull with all alveoli and containing LI^1-M^2 and RI^1-M^3. The combination of fresh-fracturing, sutural separation and thinning by digestion suggests that this vole was deposited in a raptor pellet.

Unidentified mammal, n=140: fragments less than 4 cm in length. There are four cut-marked pieces from XU 3, including the possible needle. Six tooth-marked and 92 digested fragments are scattered across the excavation area, but the 400 burned (95 charred, 305 calcined) pieces are highly concentrated in XU 2 (Feature F3-a) and are entirely absent from XUs 1, 4, and 5.

Freshwater clam, n=1: a pelecypod fragment from XU 2.

Plant remains: Samples of charcoal were collected from XU 1 (34 pieces, 2.6 g), XU 2 (13 pieces, 1.5 g), and XU 6 (21 pieces, 2.0 g), and two uncarbonized seeds were recovered from XU 5. None of these materials has been identified.

Discussion: Since five bison age/gender groups are represented among only 37 bones and teeth, the excavation appears to have intercepted part of a much larger, highly processed assemblage of bison bones. Cut marks and fracture patterns indicate filleting, dismemberment and marrow retrieval, and numerous charred and calcined fragments probably reflect roasting of unfilleted portions as well as disposal of bone scrap in the F3-a hearth.

There is evidence of light scavenging among the large mammal remains either during or after occupation of the site by people. In this layer, it is interesting that four species of carnivores are represented, primarily by teeth. Perhaps this signifies opportunistic human predation on scavengers attracted to the site by the odour of bison remains. The cut-marked badger radius suggests that such scavengers might have been welcome for their skins and perhaps for their meat.

The deer and deer or pronghorn bones may represent human use of other large mammals, but three of the four specimens are heavily tooth-marked. If a deer or pronghorn carcass were brought to the site by people, dogs might favour the more gracile bones over those of bison. We cannot ignore the possibility that a carnivore killed or scavenged such an animal independently of the human occupation, but we favour the view that they were introduced to the site by human hunters (see below). The moose bone was probably imported to the site as a tool already manufactured elsewhere, and it may have no significance from a dietary standpoint.

The meaning of the leporids is unclear. Since at least one of the bones was digested, they could have arrived at the site in the stomach of a scavenger. On the other hand, the leporid could have been snared and consumed by people and the remains subsequently scavenged. The close association of a leporid tibia with the hearth and fiscard feature (F3-a) favours the idea of human predation and use. The presence of two species (cottontail and jackrabbit) with different habitat preferences (brushy coulees and open plains) also suggests to us that planned (human) predation most easily accounts for this small sample.

From their size and condition, most of the ground squirrel bones appear to represent the same individual encountered in Layers II and Interlayer II/III (see above). The distal humerus and complete innominate represent a second individual. An extensive horizontal segment of a burrow was noted in XU 1 in Layer III, and these bones may have been in the burrow fill. The red-backed vole skull could also have originated in the fill, because it shares with the ground squirrel evidence of digestion by a raptor. The combination of raptor digestion and burrow fill suggests that a burrowing owl brought these remains to the site.

Interpretation of Layer III

The features and associated tools and debris of Layer III have been shown to be indicative of hunter-gatherer campsite activities such as heating and cooking with wood fires, wood chopping, bone breaking and consumption of parts of at least five bison, hide preparation (scraping, graining and presumably tanning), a fair amount of stone tool manufacture and repair, and other manufacturing activities involving perforation, cutting and sewing of soft materials such as skin and sinew. The presence of an arrowhead broken in manufacture is evidence for the presence of at least one man — presumably the hunter responsible for most of the animal remains found among the features. In addition, several endscrapers and chithos, presumably women's hide-working tools, indicate the presence of at least one adult woman — presumably the hunter's wife or mother. There is sufficient space and debris to allow for a few more people, but a means has not been found to distinguish other individuals. Thus, given the nature and tight clustering of the features plus the presence of at least one male and one female, it seems likely that the remains are those of a single "household."

We suspect that our exposure of Layer III contains a portion of a sheltered living floor. There were no peripheral postmolds indicative of a more permanent hunter-gatherer house structure such as a post-in-ground domed hut, and excavations were not sufficiently broad to see the farthest edges of the feature cluster. Therefore we do not know its overall shape or its complete contents. Nevertheless, the tight clustering and integrated nature of the exposed features, coupled with a tendency for larger bone fragments and tools to be situated on the peripheries of the grouping suggest a combination of confinement, arrangement, and scale of activities as might be expected within a sheltered area, possibly a conical lodge or a circular windbreak.

Whether there were other similar activity areas nearby is also a matter for speculation. One consideration is that the total amount of bone recovered from excavations is much too small to represent five whole bison, even in a pulverized state. There are many reasons why the sample might be incomplete — sampling problems in our excavation, primary butchery and discard of some elements at a distant kill site, post-occupation dispersal by scavengers, or sharing of bison among two or more households. Only broad scale exploration of the site could resolve such a question.

With respect to resource exploitation, all the animals represented by bones could have been found locally. In addition, quartzite and petrified wood/peat, the most prominent chipping materials, are available locally along the South Saskatchewan River. However, there are also indications of a somewhat more parkland or woodland orientation. At the Sjovold site animals such as moose, marten or fisher, and river otter are south of their modern distributions and at the southern limit of their early historic distributions. Although Swan River Chert left as tools and debris in the site could have come from local sources, its preferential use in finer tools such as projectile points is reminiscent of the very strong preference for this material exhibited by people who lived along the lower portions of the Saskatchewan River where Swan River chert is abundant. The presence of Gronlid Siltstone in Layer III provides conclusive evidence for a northeastern orientation since the only known sources of this material are along the Saskatchewan River in east-central Saskatchewan. The Sjovold sample had to be imported from those sources. Thus, while the Layer III occupants made good use of local prairie and parkland resources at the Sjovold site, they also left signs of having exploited resources from the woodland zone of east-central Saskatchewan as well. None of the evidence points southward or westward.

The occupation occurred between AD 850 and AD 1250 (cal 1100-700 BP; Table 3.6). The season during which Layer III was occupied has not been determined. Duration of occupation, however, can be roughly estimated using the depths of the hearths (7-8 cm), the density of fire-cracked rock (coarse rock sizes 1 and 2 provide a standardized minimal count for FCR of 299 g/m^2), density of large mammal bone fragments (106 g/m^2), chipping debris (63.1 pieces /m^2), and abandoned tools (26 specimens in 9 types for a combined density of 1.1 tools/m^2). Presumably all of this was left by one household. There is no formula which will convert these observations into an objective measure of duration. Our subjective judgement is that it was in the range of a few days to a couple of weeks.

There are several clues about the identity of the archaeological complex. The chipped stone axe is a tool type found throughout the Saskatchewan prairies and parklands with suspected associations with the Moose Jaw complex (Preston Avenue site), Laurel composite (Crown site), and/or the Avonlea complex (Preston, Crown). Chithos represent a tool type that is common throughout the subarctic, but which is also found in late prehistoric contexts in the far northern Plains, specifically in the Moose Jaw complex (Mortlach and Lake Midden sites) and the Mortlach Aggregate (Mortlach Site). The side-notched arrowhead is of a style that can be found in late prehistoric sites both in the western woodlands and in the northern Plains. The abundance of bone tools, including the moose splint awl, is typical of Terminal Woodland assemblages. However, an abundance of bone tools, including most of the types found in Layer III, is also characteristic of the Moose Jaw complex (Wettlaufer 1955:31-33). Given these clues, our guess is that Layer III belongs in the Moose Jaw complex.

Interlayer III/IV

Features: The Sjovold brothers' test pit continues through this interlayer in XU 1.

Coarse Rock: Three pieces of coarse rock were recovered, one of granite weighing 2.1 g and two of sandstone weighing 0.8 g.

Table 8.9. Stone tools from Interlayer III/IV.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole
chipping hammer	882	3	46.6	46	38	15	syenite	y
MURL	861	1	4.3	26	20	6	petrified wood	y
MURL	881	3	7.3	34	28	9	Swan River Chert	y

Stone Tools: Three stone tools were found in Interlayer III/IV (Table 8.9).

Chipping Hammer (n=1). Catno 882 is a flat ovoid pebble with pitted/crushed areas (18x6 mm, 24x7 mm) on opposing ends.

MURLs (n=2). Catno 861 is trapeziform with one blunt edge, apparently a striking platform, opposite a crushed and curved edge, and with two thinner lateral edges. One of the lateral edges was moderately sharp but apparently unused. The other was comprised of two parts: a remnant of a polished unifacially retouched edge which looks as if it had been used as an endscraper, and an adjoining irregular segment which appears to be the remainder of the scraper edge. That remainder was either broken in use or has been subject to an attempted rejuvenation which failed. Consequently, catno 861 appears to be the remains of an end scraper built on the sharp lateral edge of a squat bipolar core. Catno 881 has a rounded triangular outline. It has one continuous edge which is mainly bifacial and partly unifacial. The ventral face is roughly flat with bifacial edge flaking that affects only the margins; the dorsal face has a high central eminence scarred on all sides by flake scars originating on the edges. Apparently the stone knapper tried to remove the eminence and thin the piece, but failed and discarded it instead. Catno 881 appears to be an aborted projectile point preform.

Discussion: It is highly probable that all three tools originated in Layer III. The supposed endscraper is made on a material that was common in Layer III and was found in proximity to feature F3-c around which all the Layer III endscrapers were found. The supposed projectile point preform is made of the same material and found in the same vicinity as a projectile point broken in manufacture in Layer III. Similarly the chipping hammer was made of a material and was in a location which conforms very well to other chipping hammers from Layer III. The reasons for the displacement of these materials below Layer III is presumed to be a combination of rodent burrowing, trampling and, possibly (catno 861 only) disturbance by the Sjovold test pit.

Chipped Stone Debris: Some 324 pieces of chipped stone debris weighing 142.7 g were found in XUs 1-3 of Interlayer III/IV. Included were five chert, 18 Gronlid Siltstone, 121 petrified peat, 160 quartzite, 17 Swan River Chert and three unidentified specimens.

Discussion: There is a marked similarity between materials and proportions of chipped stone debris in this interlayer and that of Layer III above. Since most (n=311) of this material came from XU 3 where the occupation level was sloping downward, it is probable that our exposure of Layer III did not go quite deep enough in that area. Rodent burrowing was also a problem in that unit, and trampling may have been a factor.

Vertebrate Remains: This interlayer produced a small vertebrate assemblage.

Size 5-6 mammal, unidentified, n=8 (16.4 g): one tooth, four rib, a costal cartilage, two long bone shaft fragments. One rib from XU 3 exhibits a carnivore tooth puncture.

Rabbit or Hare, NISP=1 (0.2 g): hind first phalanx, from XU 3. This is from a small, immature animal with the proximal epiphysis still fusing.

Size 3 mammal, unidentified, n=1 (0.2 g): long bone shaft fragment, from XU 3. This bone was fractured when fresh and digested.

Ground squirrel, NISP=1 (0.1 g): ulna, from XU 1. The distal epiphysis is missing.

Unidentified mammal, n=100 (33.3 g): fragments less than 6 cm in length. Seven charred, two calcined, and 16 digested specimens are scattered among the three units.

Discussion: It is likely that these remains were trampled down from Layer III. The ground squirrel almost certainly belongs with the burrow-derived specimens traced from Layers II through III, and this is the deepest such specimen in the site.

Chapter 9

Layer IV-V: A Shield for Prairie Side-notched Points

Introduction and Planview

Layer IV-V was excavated in four levels in the belief that it contained two occupation layers, but subsequent analysis showed there is only one. Since preliminary reports have cited radiocarbon dates with attribution to specific numbered layers, we thought it essential to preserve the same numbering system. Therefore, we refer to the single occupation in this zone as Layer IV-V and to the next deeper occupation as Layer VI. Layer IV-V is situated between 70-79 cm BS at 2n2w and coincides with two buried soil horizons. Ahb3, the heart of Layer IV-V, at 70-75 cm BS, contained the occupation surface, two features, and a substantial quantity of cultural debris. A bone sample from the Ahb3 zone yielded a calibrated radiocarbon age in the range of AD 580-890 (S-1760). Immediately below Ahb3 is Bmkb, 75-79 cm BS, which contained traces of chipped stone (including one well-made Prairie Side-notched projectile point), coarse rock and bone debris apparently derived from Ahb3. It was penetrated by a pit feature that originated in Ahb3. A bone sample from the Bmkb zone yielded a calibrated radiocarbon age in the range of A.D. 540-890 (S-1761). By averaging the two radiocarbon measurements we infer an age of AD 650-850 (cal 1300-1100 BP; Table 3.6) for the Layer IV-V occupation. Slopes on the occupation surface in this layer were parallel those of Layer III, except for the north-south slope which was more nearly horizontal. The Sjovold brothers' test pit penetrated to the bottom of Layer IV-V mainly in the southwest quarter of XU 1. Animal burrowing was evident in the east half of XU 3 (up to 25 cm diameter), the northeast quarter of XU 2 (up to 20 cm diameter), the southeast quarter of XU 1 (up to 17 cm diameter), the north half of XU 4 (a large unfilled burrow), and the southeast edge of XU 4 (up to 30 cm diameter). Interlayer IV-V/VI extends from the bottom of Layer IV-V to the top of Layer VI. It was about 7 cm thick and contained artifacts representing both Layer IV-V and Layer VI.

The planview (Fig. 9.1) reveals two aboriginal features and two stone tools, a projectile point and a MURL. None of the piece-plotted bone is identifiable; all of the identified bison bones were recovered from XUs 4-6, south of the planview.

Features

Feature F4-a (Fig. 9.1, Table 9.1) was a hearth comprised of upper and lower parts. Beginning at about 72 cm BS was an upper lens of black and grey soil measuring about 67x75 cm in plan and 3-4 cm in thickness. Scattered through it were five small pieces of fire-broken rock. There were also two medium-size pieces of fire-broken rock on its south margin. Underlying the upper lens was a

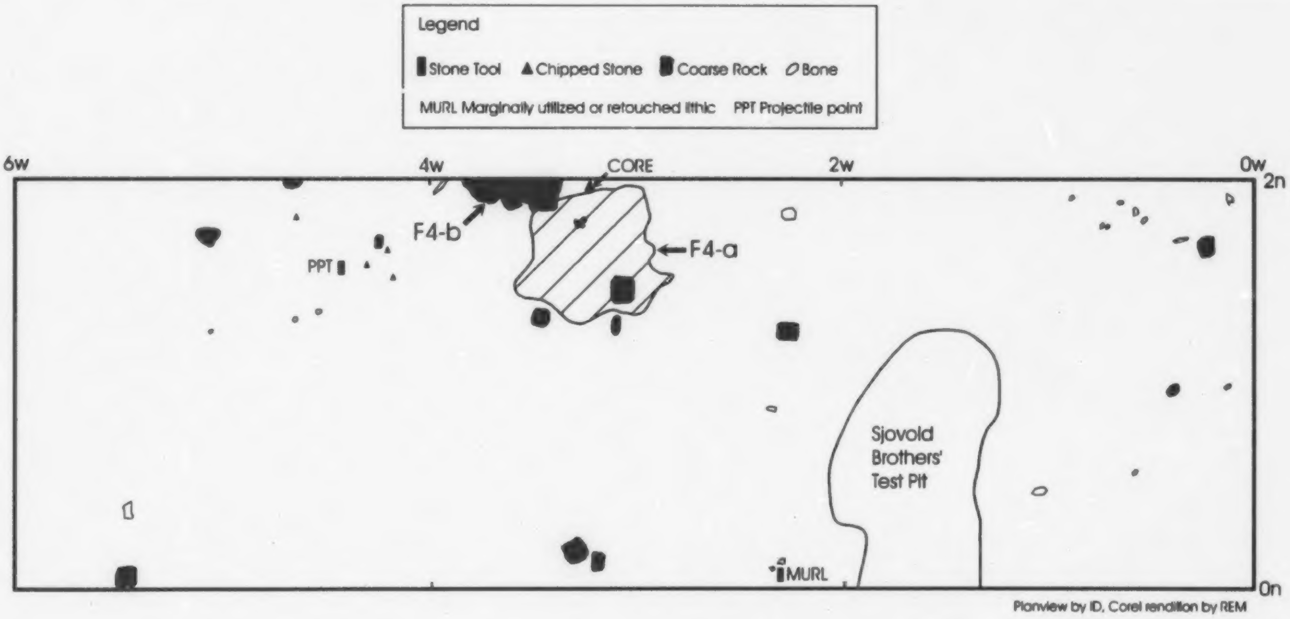

Legend
Stone Tool
▲ Chipped Stone
Coarse Rock
Bone
MURL Marginally utilized or retouched lithic
PPT Projectile point
6w
4w
CORE
2w
0w
2n
0n
F4-b
F4-a
PPT
MURL
Sjovold Brothers' Test Pit
Planview by ID, Corel rendition by REM

Figure 9.1. Planview of Sjovold Layer IV-V.

Table 9.1. Features in Layer IV-V.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F4-a	surface hearth	160n317w	67	75	7
F4-b	shield-making pit	210n362w	>15	50	35

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

concave zone of fire-reddened earth about 3-4 cm in thickness. Its diffuse boundaries extended 20-30 cm farther to the south and east and a bit less to the west than the upper zone. Except for F4-b, adjoining immediately to the northwest, the area around F4-a was almost devoid of archaeological remains for a distance about 25 cm. Beyond that was a sparse scattering of broken rock, chipped stone and bone for the next meter or more. Since the surface charcoal and ashy soil did not cover the full extent of the underlying fire-reddened earth, the upper part of the feature must have been eroded, perhaps by wind, prior to burial. This may be an indication that the fire was never under a shelter. The underlying reddened soil is an indication that the fire burned very hot and longer than one short episode.

Feature F4-b was a tight pile of severely weathered pinkish cobbles and cobble fragments. Most of the stone was granite and sandstone, but there was also at least one slab of black gneiss. Only about the southern third of the feature was exposed and only part of that was dismantled in the course of our excavations. The rest is still buried *in situ*. In profile this group of stones was about 50 cm east-west and about 35 cm in depth. The basal rocks were arranged in a deeply concave configuration which indicated that they were in a pit (see Fig. 9.2). We could not trace the walls of the pit other than by the position of the rocks, because there was too little colour contrast between soil among the stones and outside them. As best we could see, the rocks occupied the whole pit in roughly three layers. Spaces between rocks were filled with soil. The highest stone, approximately centered at the crown of the pile, had an elevation of 66 cm below the modern surface, 6 cm above the top of the adjoining surface hearth. We interpret F4-b as a heating device, its cobbles having been heated to a high temperature on the adjoining hearth and rolled into the pit. Such a cluster of hot rocks would give off a great deal of heat for a considerable time — an hour or more per heating. There are at least a couple of possibilities for how such a feature may have been used.

Hot rocks in a sweat lodge. North American native people are known to have made regular use of small domed saunas (sweat lodges) for both religious and simple cleansing reasons. There are many descriptions of such sweat lodges in the ethnohistoric literature. For example, referring to Cree Indian territory along the North Saskatchewan River, Jefferson (1929:56-57) described the remains of what he called "sweat tents."

Figure 9.2. Profile view of F4-b, a possible shield-making pit. RSM #EiNs-4:79-177 CT.

A diversion to which the Indians are excessively addicted — males, that is, not women and children — is the Sweat-Tent. It is rather an indulgence, since they treat themselves to it as often as twice a day. At every old camp one comes across the relics of this habit — a few granite stones, the size of one's head, in a hole in the ground.

A big fire is built and the stones thrown in to the heat, while a bunch of willow sticks are cut, and stuck, butt ends into the ground, in a circle five or six feet across. The branch parts are brought together and interlaced into a rounded top, making a framework the shape of an overturned bowl. Over this frame blankets and robes are thrown for a covering. Inside, a hole, a foot in diameter and a foot deep, is dug out with a knife. A small kettle of water; a wisp of long grass, with the stones red hot, and the preparations are complete. A green willow, doubled into the form of pincers, is used to transfer the stones from the fire to the hole inside. The men — as many as the booth will accommodate, strip themselves to the breech-clout, and squeeze inside, when the covering blankets are closed to exclude the air. With the wisp of grass the water is now sprinkled on the hot stones and the steam arising fills the place until it oozes out through the cracks of the covering. Deep grunts, perhaps songs, testify to the intense satisfaction of the bathers, who, when they have had enough, throw aside the coverings

> and emerge with the sweat streaming from every pore. They scoop off what they can of the water and dry themselves with a cotton rag or a handful of grass; then they pull on their leggings, wrap the blankets around their shoulders and wait, quite clean, for the next time. In winter the sweat-tents are erected inside their houses, which is easy, since the floor is of earth.

Hassrick (1964:227-228) provides another example referring to Sioux Indians:

> A dome-shaped frame was fashioned from willow poles, much as a small wigwam was constructed. Over the willow frame, robes were placed in such a manner that the lodge would be airtight. Near the center a small pit or *iniowaspe* was dug to serve as a receptacle for the heated stones, while around the floor of the lodge was spread a blanket of sage. Purification lodges were so located that the entrance faced toward the east. The earth which was removed from the *iniowaspe* was made into a little mound about two paces distant from the entrance and just in front of the pile of rocks and firewood where the stones were to be heated. This mound was called the *hanbelachia* or the vision hill. Between the vision hill and the *iniowaspe* the earth was cleared to form a path known as the *smoothed trail*. The *iniowaspe*, the *hanbelachia*, and the smoothed trail represented in symbolic miniature the vision quest.

There are many such descriptions. Together they reveal a pattern for sweat lodge construction and use: making a small domed hut; digging a central hole in the earthen floor; heating stones on an outside fire; rolling or carrying the hot stones to the hut's hole; then sprinkling water on the stones to make a sauna. The combined hearth and rock pit features in Layer IV-V conform to most of these characteristics. Although there were no postmolds for a domed structure around the pit, that could easily be due to the very faint difference in colour between the occupation surface and subsoil at this location. It is predictable that such small posts would leave little or no archaeological trace. There is one further problem, however, in identifying F4-b as the remains of a sweat lodge — the very close proximity of hearth, F4-a. The two features were virtually touching one another. How, in such a situation, could the stones have been heated without destroying the structure of the sweat lodge? It is possible, one supposes, that the stones were heated and rolled into the pit first, then the fire was extinguished and the lodge was erected. Such a sequence of events seems a bit contrived. It might be argued that the rock pit and hearth are not strictly contemporary — part of the same occupation but not part of the same group of activities. However, the lack of artifacts around the hearth means that we have no clues about what such other hypothetical activities might have been. It seems simpler to assume that the two features are related.

Shield-making pit. Another possibility is that the rock pit functioned as a heating or steaming device in a small manufacturing operation, a Northern Plains example being the shield-making pit. Several methods of shield-making, all involving pits, have been observed in the Northern Plains. For example, Lewis and Clark (1814:309-310) observed one method of shield-making, by Shoshone Indians, during their famous trip up the Missouri River in the early 1800s.

> The shield is a circular piece of buffaloe hide about two feet four or five inches in diameter, ornamented with feathers, and a fringe round it of dressed leather, and adorned or deformed with paintings of strange figures. The buffaloe hide is perfectly proof against any arrow, but in the minds of the Shoshones, its power to protect them is chiefly derived from the virtues which are communicated to it by the old men and jugglers. To make a shield is indeed one of their most important ceremonies: it begins by a feast to which all the warriors, old men and jugglers are invited. After the repast a hole is dug in the ground about eighteen inches in depth and of the same diameter of the intended shield: into this hole red hot stones are thrown and water poured over them, till they emit a very strong hot steam. The buffalo skin which must be the entire hide of a male two years old, and never suffered to dry since it was taken from the animal, is now laid across the hole, with the fleshy side to the ground, and stretched in every direction by as many as can take hold of it. As the skin becomes heated, the hair separates and is taken off by the hand; till at last the skin is contracted into the compass designed for the shield. It is then taken off and placed on a hide prepared into parchment, and then pounded during the rest of the festival by the bare heels of those who are invited to it. This operation sometimes continues for several days, after which it is delivered to the proprietor, and declared by the old men and jugglers to be a security against arrows; and provided the feast has been satisfactory, against even the bullets of their enemies....

Features F4-a and F4-b conform fairly closely to this description of a shield-making pit and rock-heating hearth complex, but the proximity of the hearth to the pit remains a problem. Such close spacing would have facilitated the rolling of heated rocks into the pit, and it would not have burned any nearby structure since none was required, but the coals of the fire would have interfered with the access of skin "tuggers" to the edge of the pit. In answer to this, it might be imagined that, after heated rocks had been rolled into the pit from the hearth, the fire was extinguished to clear the pit perimeter for tuggers. The observed absence of part of the charcoal and ash from the hearth surface might thus be accounted for.

During the 1830s, George Catlin (1844:I, 241) observed another variation of shield-making by Sioux Indians at the junction of the Teton and Missouri rivers:

> The process of "*smoking the shield*" is a very curious, as well as an important one, in their estimation. For this purpose a young man about to construct him a shield, digs a hole of two feet in depth, in the ground, and as large in diameter as he designs to make his shield. In this he builds a fire, and over it, a few inches higher than the ground, he stretches the raw hide horizontally over the fire, with little pegs driven through holes made near the edges of the skin. This skin is at first, twice as large as the size of the required shield; but having got his particular and best friends (who are invited on the occasion,) into a ring, to dance and sing around it, and solicite the Great Spirit to instil into it the power to protect him harmless against his enemies, he spreads over it the glue, which is rubbed and dried in, as the skin is heated; and a second busily drives other and other pegs, inside of those in the ground, as they are gradually giving way

> and being pulled up by the contraction of the skin. By this curious process, which is most dexterously done, the skin is kept tight whilst it contracts to one-half of its size, taking up the glue and increasing in thickness until it is rendered as thick and hard as required (and his friends have pleaded long enough to make it arrow, and almost ball proof), when the dance ceases, and the fire is put out. When it is cooled and cut into the shape that he desires, it is often painted with his *medicine* or *totem* upon it, the figure of an eagle, an owl, a buffalo or other animal, as the case may be, which he trusts will guard and protect him from harm; it is then fringed with eagles' quills, or other ornaments he may have chosen, and *slung* with a broad leather strap that crosses his breast. These shields are carried by all the warriors in these regions, for their protection in battles, which are almost invariably fought from their horses' backs.

This method does not provide a good analogy since there was no trace of fire residues within the Layer IV-V pit feature. Rather, in Layer IV-V the hearth was clearly beside the pit. This Sioux example does show, however, that shielding-making was not limited to methods requiring steam, but could also be accomplished by direct application of heat to bull hide.

Yet another variant of shield-making was described by Kroeber (1908:151) for the Gros Ventre:

> Shields were made of the thickest part of buffalo skin, which was laid into a hole in the ground and made hard by being scorched with hot rocks placed upon it. It was then provided with a cover of white buckskin fringed with feathers. A man who carried a shield in war sometimes had no other weapon.

If the Gros Ventre method had been used in Layer IV-V, then proximity of the hearth to the pit would not have been a significant inhibition to the hide-scorching operation. Moreover, after the scorched hide had been pulled out of the pit, the rocks might well have been left behind as we found them in feature F4-b. Therefore, our preferred interpretation for features F4-b and F4-a is that they were the scorching pit and rock-heating hearth of a shield-making operation which used the Gros Ventre method.

Possible additional feature south of F4-a and F4-b. The excavation method applied to XUs 4-6 in Layer IV-V precluded most feature observations. We observed, however, that the amounts of coarse rock and chipped stone debris in XU 6 were quite high (see below). Some sort of feature seems to have been indicated by these concentrations.

Rock

Coarse rock from Layer IV-V includes some 141 specimens weighing 9.7 kg (Table 9.2) in two concentrations. The rock in pit feature F4-b, is partly represented in the total for XU 2. The other concentration was in XU 6. The largest portion of Layer IV-V rock is gneiss (44.0% by weight).

Table 9.2. Coarse rock from Layer IV-V.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
andesite	2	1	-	-	-	-	3
chert	-	-	-	-	-	1	1
gabbro	-	-	-	1	-	-	1
gneiss	2	22	-	2	4	6	36
granite	2	45	12	2	-	2	63
limestone	1	5	-	1	1	-	8
mudstone	-	-	-	-	1	-	1
quartzite	-	-	-	1	-	4	5
quartz	-	1	-	-	-	2	3
shale	-	-	-	-	-	3	3
sandstone	-	1	4	-	-	-	5
silicified sediment	-	-	-	1	-	-	1
unidentified	2	-	1	-	-	8	11
Total	9	75	17	8	6	26	141
Weight							
andesite	4	1	-	-	-	-	5
chert	-	-	-	-	-	67	67
gabbro	-	-	-	273	-	-	273
gneiss	188	932	-	132	149	2,863	4,264
granite	31	1,518	856	90	-	1,110	3,605
limestone	41	192	-	10	24	-	267
mudstone	-	-	-	-	2	-	2
quartzite	-	-	-	155	-	453	608
quartz	-	249	-	-	-	6	255
shale	-	-	-	-	-	5	5
sandstone	-	1	284	-	-	-	285
silicified sediment	-	-	-	1	-	-	1
unidentified	3	-	46	-	-	8	57
Total	267	2,893	1,186	661	175	4,512	9,694

Other well-represented types are granite (37.2%) and quartzite (6.3%) with gabbro, limestone, quartz and sandstone showing only 2-3% each. The rocks are almost all fire-broken. All of the coarse rock materials in Layer IV-V could have come from the nearby creek valley slopes or from the creek and river bed. Though the figures are somewhat similar to the natural abundance of various rock types in local sources (Dyck 1990), gneiss is considerably more abundant in the site and seems to have been selected for, while quartzite, limestone, and andesite are less abundant in the site than in local sources and seem to have been selected against. Granite and gneiss are optimum choices for fire-heating (Blackwelder 1927; Tarr 1915; Toom and Baumann 1983).

Pottery

We discovered one piece of native pottery (catno 2274) in XU 5 of Layer IV-V. It is the exterior part of a body sherd measuring 16x16x3 mm and weighing 1.2 g. The sherd is tempered with crushed granite up to 3 mm in diameter. The exterior surface is dark greyish brown (10YR 4/2) and has been smoothed almost to the point of obliterating small surface indentations — apparently netting knot impressions. These characteristics are very similar to those of Vessel F which was found deep in Layer VI and on the top of Layer VII almost directly below. Given the observed animal burrows in this section of the site, and previous evidence that pottery had been brought up from those deeper layers, it seems likely that this piece, too, was intrusive.

Table 9.3. Stone tools from Layer IV-V.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
endscraper	2247	4	2.1	21	15	5	Swan River Chert	y	9.3d
MURL	903	3	4.6	31	21	7	petrified peat	n	9.3h
MURL	912	2	2.8	24	23	7	Knife River Flint	?	9.3j
MURL	2275	5	4.8	34	24	6	Swan River Chert	y	9.3f
MURL	2278	5	1.2	26	16	3	Knife River Flint	y	9.3e
MURL	103	*0	2.1	39	15	6	petrified wood	?	9.3i
pointed biface	2279	5	5.8	44	36	4	petrified peat	n	9.3g
projectile point	904	3	0.4	7	16	3	chert	n	9.3c
projectile point	948	3	2.8	34	18	4	Swan River Chert	y	9.3a
projectile point	2283	5	3.4	31	22	9	silic. sediment	?	9.3b

* found in Test Profile No. 2.

Stone Tools

Nine stone tools were recovered within XUs 1-6, and one was found near the south edge of XU 5 in Layer IV-V of test profile 2 (Fig. 9.3; Table 9.3).

Endscraper (n=1). One small endscraper was found in XU 4. It is made on the distal end of a parallel-sided and dorsally ridged flake of coarse-grained yellowish Swan River Chert. The only retouching is on the distal or working edge where the edge angle is very steep, on the order of 85°. It appears that an attempt to sharpen that edge was frustrated by step fractures. Nevertheless, the partially retouched edge shows slight wear, and some additional scraping may have been attempted before the item was discarded.

MURLs (n=5). The MURL category contains several kinds of retouched and/or utilized edges. Catnos 903 and 2275 are pieces of shatter each with an edge segment (less than half of the

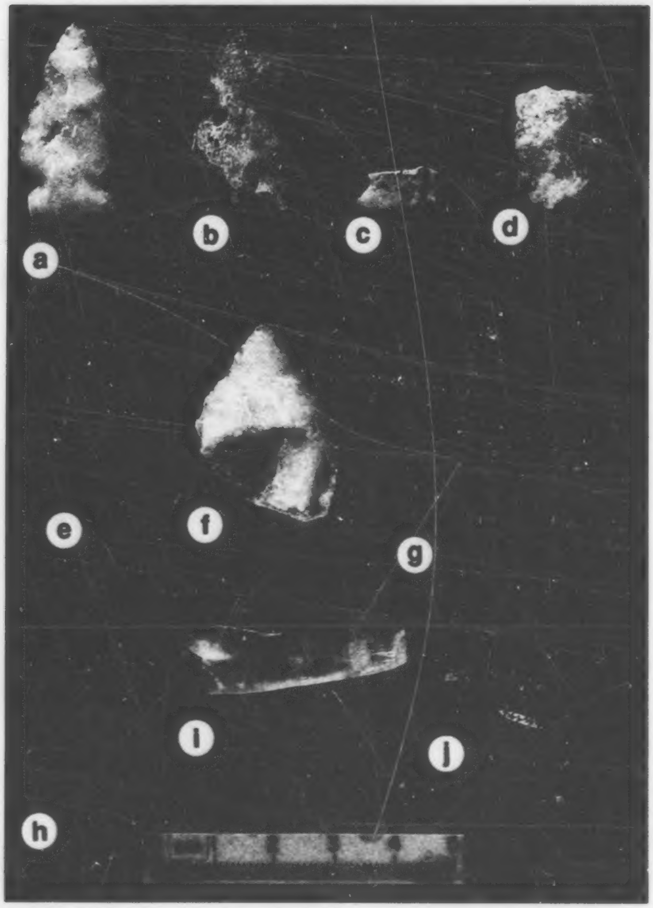


Figure 9.3. Stone tools from Layer IV-V. a-c, projectile points; d, endscraper; e-f, h-j, MURLs; g, pointed biface.

circumference) which has been bifacially retouched. These pieces have the appearance of being aborted attempts at tool-making. Catnos 912 and 103 are ridged pieces of shatter with unifacial retouch and/or use wear along one or both lateral edges. Catno 912 has unifacial retouch, dulled by use, along its longest sharpest edge plus an irregular series of small flake scars, presumably due to use wear alone, on its shorter steeper lateral edge. Catno 103, a long thin translucent piece, has unifacial retouch along the dorsal face of one half of its longest sharpest edge, and the retouching continues on the reverse face of the other half of the same edge. Both parts of the catno 103 edge show moderate wear and polish from the apex of the edge slightly onto the flake scars. Catnos 912 and 103 were likely used as fine cutting instruments on a medium-soft material such as sinew, hide or even a small piece of wood. Catno 2278 is a thin contracting flake which has had one sharp lateral edge slightly crushed through use. The other edge was lightly unifacially retouched, then lightly worn and polished. On that same edge, near the proximal end (original flake striking platform), a pointed projection measuring 3x3 mm, was created using unifacial retouch. The tip of the projection is slightly crushed and its edge is slightly polished. It could have been used either as a fine perforator or as a fine incisor. Thus, it would appear that catno 2278 served both as a fine cutting implement and as a fine perforator/incisor.

Pointed biface (n=1). Three conjoining pieces (catnos 2276, 2277, 2279) of a pointed biface were found in XU 5. When fitted together they reveal two nearly straight edges leading to a point. The edges have been bifacially retouched leaving overlapping flake scars which extend between 5-7 mm inward from the margins. These edges are very sharp with no signs of wear. It appears that the tool was broken during manufacture. After reconstruction the three pieces comprise less than half of a larger item which must have been on the order of 100 mm long but only 4 mm thick. This seems like an inherently fragile length to thickness ratio and one wonders what function such a tool could have served had it remained whole.

Projectile points (n=3). Catno 904 is the base/haft section of a straight based, side-notched projectile point made of a banded white, off-white and grey chert. The basal edge is ground or worn smooth, as are the lateral edges up to the notches. The notches begin a little more than 1 mm above the basal edge and have a rounded "v" shape. This suggests that the point belongs to the Prairie Side-notched type (Kehoe 1966b; Dyck 1983). The upper part of the haft, the body and the tip are missing, the point having broken along a line joining the notches. Catno 948 is a complete Prairie Side-notched point made of mottled white and grey chert. The basal edge is slightly convex and well ground or smoothed. The notches begin about 1 mm above the base, have a rounded "v" shape, and measure 5 mm wide by 3-4 mm deep. A small piece (1-2 mm) of one notch-body juncture has been broken off. The damage is hardly noticeable. The lateral edges are partly freshly chipped, partly worn. The tip is sharp but shows moderate wear on both edges. Application of the Thomas (1978) discrimination equations for arrowheads and darts yields values of $C_{dart} = 11.51$ and $C_{arrow} = 8.42$ for catno 948. This indicates use as a dart, a weapon we are not accustomed to thinking about for the Late Prehistoric Period. Catno 2283 refits with catno 2284 making what, at least in outline, appears to be a complete projectile point with corner-removed notches. This is a crude affair, made of a low grade grey silicified sediment. One lateral edge is naturally thin except for a couple of small flake scars and the other edge is either marked or truncated by a thick vertical fracture. One would not even consider these pieces to be a projectile point were it not for the notches and base which appear to be deliberately crushed and chipped into the basic configuration of a projectile point haft. It appears that the piece was never destined to become a functional point. When it broke it may simply have been the object of idle chipping practice, or it may have been a facsimile projectile point used as an offering.

Discussion: The stone tool assemblage from Layer IV-V is compatible with the interpretation of the nearby features as remains of either a sweatlodge or of a small manufacturing operation such as a shield-making enterprise. In either case, the presence of males in the vicinity would be expected and the projectile points indicate such a presence. In the case of the shield-making interpretation the rest of the tools could also be implicated — endscraper to prepare the main skin, small knives to trim it and a perforator to sew on a buckskin covering with a feather fringe.

Table 9.4. Chipped stone debris, excluding cores, from Layer IV-V.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
agate	1	-	-	-	-	-	1
chert	-	-	1	1	4	14	20
Gronlid Siltstone	-	-	-	-	-	2	2
Knife River Flint	-	-	1	-	-	-	1
limestone	-	-	-	-	-	6	6
petrified peat	-	3	13	3	1	3	23
quartzite	-	6	7	-	-	18	31
quartz	-	-	1	-	-	-	1
Swan River Chert	1	-	1	-	-	1	3
silicified sediment	-	1	1	2	-	-	4
Total	2	10	25	6	5	44	92
Weight							
agate	0.6	-	-	-	-	-	0.6
chert	-	-	0.3	1.1	10.7	17.5	29.6
Gronlid Siltstone	-	-	-	-	-	1.1	1.1
Knife River Flint	-	-	0.3	-	-	-	0.3
limestone	-	-	-	-	-	3.8	3.8
petrified peat	-	0.4	7.8	6.8	1.4	3.7	20.1
quartzite	-	2.0	18.2	-	-	27.8	48.0
quartz	-	-	1.4	-	-	-	1.4
Swan River Chert	0.1	-	0.2	-	-	0.6	0.9
silicified sediment	-	0.0	6.6	1.2	-	-	7.8
Total	0.7	2.4	34.8	9.1	12.1	54.5	113.6

Table 9.5. Chipped stone cores from Layer IV-V.

Type	Catno	XU	Weight	Size*	Material
bipolar	2320	6	17.3	b	chert
bipolar	2293	5	101.9	c	petrified wood
bipolar	2319	6	15.6	b	chert
bipolar	909	2	32.1	b	petrified peat

* size refers to categories based on greatest length: (a) 13-25mm, (b) 26-49 mm, (c) 50-100 mm, (d) 100-149 mm, and (e) 150 mm and larger.

Chipped Stone Debris

The chipping debris (Tables 9.4, 9.5) is predominantly (by weight) quartzite (42.3%), chert (26.5%), petrified peat (17.7%) and silicified sediment (6.9%). All of these materials could have been obtained in local surface drift or river-edge cobble deposits. Chipping left only medium to small debris. Silicified sediment, quartzite, chert, and quartz all fall into the medium category with average weights ranging from 2.0 to 1.4 g per specimen. Petrified peat, agate, limestone/chert, Gronlid Siltstone, Knife River Flint and Swan River Chert fall into the small category with average weights less than 1.0 gram per specimen. This is the situation one might expect if the chipping was comprised of a small amount of retouching (rejuvenation) of tools that had been carried to the site, together with intensive reduction of a few pieces of raw material to make new tools. All cores are of the bipolar variety and all core materials are locally available (Fig. 9.4; Table 9.5).

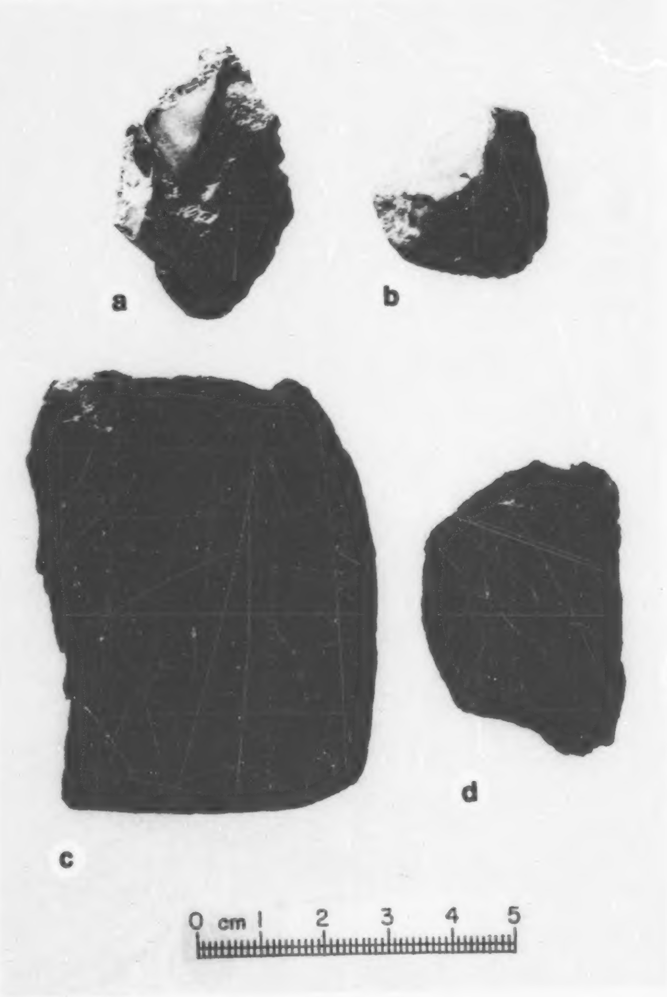


Figure 9.4. Chipped stone cores from Layer IV-V. a, EiNs-4:2320; b, 2319; c, 2293; d, 909.

There is a fair degree of similarity among materials represented by chipping debris and stone tools, with petrified peat, petrified wood, chert, Swan River Chert, Knife River Flint and silicified

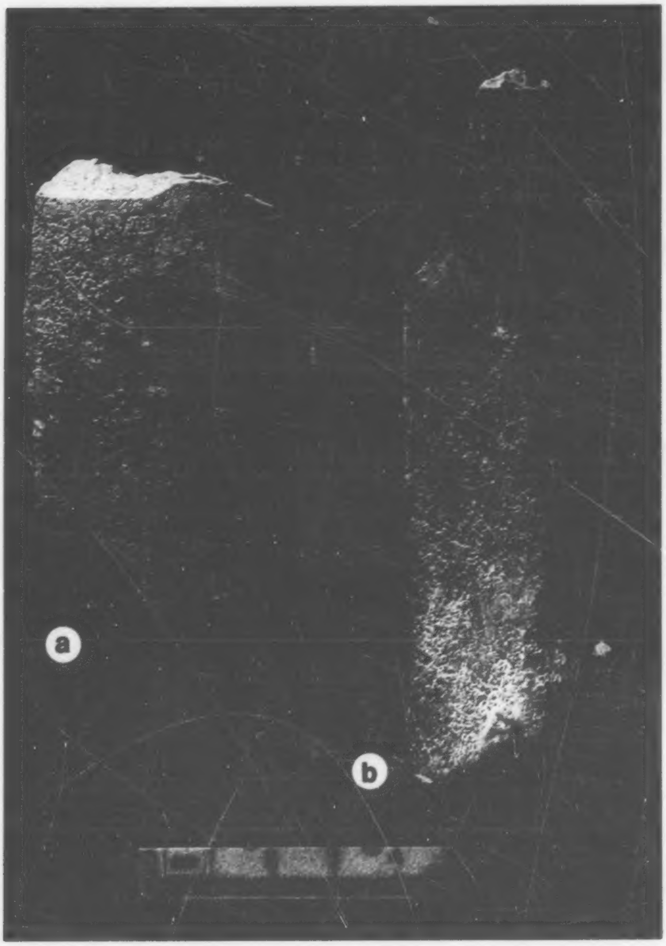


Figure 9.5. Bone chopper bits from Layer IV-V. a, EiNs-4:2265; b, 222.

sediment being found among both. However, the largest debris category, quartzite, is not represented among the tools. This could simply mean that a quartzite tool(s) was made at the site and carried away. As to distribution, the bulk of the chipping debris was at the west end of our excavations, in XU 3 and especially in XU 6. Stone tools were also concentrated in the west end of our exposure, but they tended to surround XU 6 with three tools in XU 3, one in XU 2, four in XU 5 and one on the south edge of XU 5. Thus nine of ten stone tools were found on north and northeast peripheries of the chipping debris in XU 6, but there were no stone tools in XU 6 itself. These distributions suggest that additional activities and features may have existed in XU 6 and beyond to the southwest. A final observation concerns the sources of materials. The majority of the chipped stone from Layer IV-V reflects the use of local sources. However, there are also exotic materials present in small amounts indicating commerce or travel up to 250 km to the northeast (Gronlid Siltstone) and up to 500 km to the southeast (Knife River Flint).

Bone Tools

Four bone tools include two chopper bits, a pressure flaker fragment, and a hide grainer. The bit of a bison humerus chopper was found in XU 4 (catno 2265). The teres tuberosity is preserved on this specimen, and its orientation indicates that the chopper handle would have been the distal end of the bone (see Fig. 9.5). A bison tibia chopper bit was found in Profile 3 (catno 222) in a position correlated with Layer IV-V. This chopper was formed on the distal third of the medial face of the tibia with the handle being the distal end; the surviving bit is broken off just above the medial malleolus.

Only a 22 mm long fragment of the pressure flaker was found. It is made on a large mammal rib from XU 2 (catno 8094), and it has a rounded working tip beveled toward the lateral surface of the rib.

The hide grainer, from XU 5 (catno 2294; see Fig. 4.1), is made on the distal end of a bison left metacarpal. It has been only slightly used on the anterior/lateral corner.

Faunal Remains

Approximately 250 g of bone from Layer IV comprised a radiocarbon sample (S-1760) selected from XUs 1-3, and all other vertebrate remains are reported in Tables 9.6-9.7.

Bison, NISP=6: anterior rib, humerus shaft, ulnar semilunar notch, distal metacarpal ♂, front 2nd phalanx, talus ♂. The humerus shaft fragment includes the teres tuberosity, and the piece is a broken chopper bit. The ulna fragment has been gnawed by a carnivore, weathered to Stage 1, and then broken.

Size 5-6 mammal, unidentified, n=33: five tooth, 15 rib, one scapula, 12 long bone shaft fragments. Multiple cut marks are present on a long bone fragment from XU 4 and on a rib fragment from XU 6. Cut marks on the end of a rib in XU 2 are associated with the use of the specimen as a pressure flaker. One rib from XU 4 has been gnawed by a carnivore.

Deer or Pronghorn, NISP=3: three long bone shaft fragments. One of these is very similar to deer but cannot be definitely identified; it exhibits carnivore tooth punctures on the shaft.

Size 4-5 carnivore, unidentified, n=1: phalanx shaft. This specimen is pitted and thinned by digestion and must have passed through the gut of a carnivore.

Size 4 mammal, unidentified, n=1: cheek tooth crown. The tooth crown is worn flat and cannot be matched with any available reference material.

Table 9.6. Vertebrate remains from Layer IV-V.[a]

Size, Taxon	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
6, Bison	-	-	-	1	5	-	6
5-6, mammal	3	1	2	11	9	7	33
5, Deer or Pronghorn	-	-	-	-	3	-	3
4-5, Carnivore	-	-	1	-	-	-	1
4, mammal	1	-	-	-	-	-	1
3, Rabbit or Hare	1	1	-	*6	1	-	9
3, Cottontail	-	-	-	*14	-	-	14
3, Snowshoe Hare	-	-	-	*14	-	-	14
2, Ground Squirrel	-	-	-	*5	-	-	5
-, mammal	53	97	35	147	93	129	554
Total	58	99	38	198	111	136	640
Weight							
6, Bison	-	-	-	55.9	292.7	-	348.6
5-6, mammal	22.4	0.5	6.9	59.5	67.9	28.9	186.1
5, Deer or Pronghorn	-	-	-	-	10.3	-	10.3
4-5, Carnivore	-	-	0.4	-	-	-	0.4
4, mammal	0.6	-	-	-	-	-	0.6
3, Rabbit or Hare	0.2	0.2	-	1.3	0.2	-	1.9
3, Cottontail	-	-	-	10.6	-	-	10.6
3, Snowshoe Hare	-	-	-	8.0	-	-	8.0
2, Ground Squirrel	-	-	-	0.6	-	-	0.6
-, mammal	25.5	31.0	14.7	53.0	34.5	44.6	203.3
Total	48.7	31.7	22.0	188.9	405.6	73.5	770.4

a. Superscripts (*) signify that all of these elements are thought to be intrusive into this layer.

Rabbit or Hare, NISP=9: mandibular symphysis, mandible body fragment, two ribs, distal scapula, ilium, acetabulum with ischium, 1st phalanx, 2nd phalanx. The scapula is from either a snowshoe hare or a cottontail. It and the mandible body fragment have been digested, and the symphysis and innominate fragments exhibit carnivore tooth punctures. All but the symphysis, scapula and 1st phalanx are believed to have originated in the loosely infilled (badger?) burrow that intruded into XU 4.

Nuttall's Cottontail?, NISP=14: skull with all teeth except LI^2, two mandibles with teeth, a lower cheek tooth, atlas, axis, 3rd and 4th cervical vertebrae, distal tibia, calcaneus, metatarsals II, III, IV, and V. The skull is neither crushed nor filled with sediment, and all of these elements are distinctively stained and devoid of rootlet etching. We attribute all of them to the loosely infilled (badger?) burrow that penetrated XU 4 at this level.

Snowshoe Hare, NISP=14: two mandibles with teeth, atlas, axis, 3rd cervical, 1st, 9th, and

Table 9.7. Modified vertebrate remains from Layer IV-V.[a]

								Fracture States				
Size, Taxon	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	-	-	1	-	1	5	-	-	1	4	1	6
5-6, mammal	3	-	-	1	*	*	5	-	10	18	-	33
5, Deer or Pronghorn	-	-	1	-	-	2	-	-	-	3	-	3
4-5, Carnivore	-	-	-	1	-	-	-	-	-	1	-	1
4, mammal	-	-	-	1	-	-	1	-	-	-	-	1
3, Rabbit or Hare	-	-	3	2	-	-	-	-	-	5	4	9
3, Cottontail	-	-	-	-	-	-	1	-	-	1	12	14
3, Snowshoe Hare	-	-	-	-	-	-	-	-	-	2	12	14
2, Ground squirrel	-	-	-	2	-	-	-	-	1	1	3	5
-, mammal	3	14	1	48	*	*	-	*	*	*	-	554

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

12th thoracic, two lumbar vertebrae, proximal radius, proximal ulna, metatarsals IV and V. In view of their distinctive staining and lack of rootlet etching we attribute all of these elements to the loosely infilled burrow.

Ground Squirrel, NISP=5: mandible with I_1-M_2 alveoli and containing an unworn I_1, axis, lumbar vertebra, scapula, distal femur. The mandible and femur are covered with fecal material, demonstrating digestion by a mammal. Since the femur has a fused epiphysis it represents an adult ground squirrel, whereas the unworn incisor shows that the mandible is from a fetal or neonatal individual. With distinctive staining, no rootlet etching, and evidence of digestion, we attribute all of these elements to the loosely infilled burrow in XU 4.

Unidentified mammal, n=553: fragments less than 4 mm in length. Two specimens from XU 1 and one from XU 5 bear cut marks. Burned pieces include nine charred and two calcined fragments in XU 2 and three charred ones in XU 6. The XU 2 examples are associated with a surface hearth (F4-a). One specimen from XU 5 is tooth-punctured, and of 48 digested fragments, small concentrations in XUs 4 and 5 were deposited in scats.

Snails: XUs 4 and 5 each yielded one small gastropod.

Plant remains: A small sample of charcoal (six pieces, 0.9 g) was collected from XU 2 (F4-a), and an assemblage of noncarbonized seeds was recovered from the burrow that contained leporid and ground squirrel bones.

Discussion: From the evidence of cut marks and tool use, portions of an adult bull bison were utilized by people in Layer IV-V. However, all other categories of vertebrate faunal remains are heavily altered by carnivore gnawing and digestion. Most of the leporid and all of the ground squirrel elements are thought to have originated in a large burrow where they probably represent the partly consumed food supply of a badger. For other taxa, the relationship to the archaeological deposits is not clear.

Interpretation of Layer IV-V

Our exposure of Layer IV-V revealed a pit filled with whole cobbles and large pieces of fire-cracked rock. Adjoining the pit was a surface hearth. The best interpretation for these features would seem to be that of a small manufacturing operation requiring great heat. A shield-making pit is the kind of operation that could be represented. For shield-making the objective would have been to shrink a large piece of raw bison hide into an almost impenetrable core for a shield. Several lines of evidence support this interpretation. For one thing, shield-making is a task that requires a bull bison hide and the sole bison identified among the animal remains is, indeed, a bull. Moreover, shields were often covered with a finer tanned skin. Bones of a cervid which could have provided such a skin and the tools to prepare it (endscraper) and to cut and sew it (knife and MUPLs) are present. An incisor or graver with which a fringe of feathers could have been added is also present. Ethnographic descriptions of shield-making indicate that it was a ceremonial task carried out by males (Catlin 1844:v.1, p. 241; Catlin 1858?:74; Mooney 1910b:547; McCoy 1984:12). Projectile points in the Layer IV-V collection show the presence of males. Finally, shield-making was often accompanied by a feast. The concentration of fire-cracked rock and chipped stone in XU 6 and the bits of humerus and tibia choppers that could have been used to dismember animals may be an indication of an activity area where such a feast was prepared.

It seems unlikely that this occupation was of long duration, because both chipping and bone debris were fairly sparse. A single day or, at most, perhaps a few days occupation by a few men and boys would have been sufficient to produce all the remains we recovered. We do not know if there was a shelter in the vicinity of this operation. The suspected feast site would have been on the brink of the creek bank and that would seem an unlikely site for a shelter. The region utilized by site occupants was primarily local as shown by the predominance of locally available stone types among the chipping debris and tools. However, both the North Saskatchewan River and the Missouri River were within their range of travel or trade as shown by traces of Gronlid River Siltstone and Knife River Flint among the trash and discarded tools. Projectile points are the sole evidence for the cultural identity of the Layer IV-V occupants. Both functional points are of the Prairie Side-notched type. Our age estimate of AD 650-850 (cal 1300-1100 BP; Table 3.6) overlaps the early-middle part of the time range established elsewhere for Prairie Side-notched points (cf. Dyck 1983:129; Morlan 1993a:40).

Interlayer IV-V/VI

This interlayer was excavated as a separate unit only in XUs 1-3. In XUs 4-6 the materials of Layer IV-V and those of Interlayer V/VI were excavated as one unit and are described above.

Features: The bottom of the Sjovold test pit was reached in Interlayer V/VI of XU 1. The middle and lower parts of F4-b also penetrated the interlayer. No other features were evident.

Coarse Rock: Ten pieces of coarse rock weighing 31 g were recovered from XUs 1 and 2. There were five pieces in each unit including one of amphibolite, two andesite, six limestone and one silicified sediment. All have sharp angular edges and appear to have been the result of either heat fracturing or human chipping.

Pottery: Eight sherdlets of pottery, apparently all part of a single vessel with a parallel grooved, smoothed, greyish brown (2.5Y 5/2) exterior surface were found in XU 2. The vessel they belong to had walls that were about 7 mm thick. Its core was charcoal-coloured and tempered with crushed granite about 1 mm in diameter. Its interior surface was smoothed and also charcoal coloured. These characteristics are strikingly similar to those of Vessel D which was recovered in quantity from Layer VI. It is probable that we skimmed the small interlayer sample from the top of Layer VI.

Stone Tools: The bit of an endscraper (catno 958) was found in XU 1. Made of petrified wood, it measures 16x7x6 mm and weighs 1.1 g. Catno 958 has steep unifacial retouch along one edge with light wear/polish on the edge itself. There are step fractures about 2 mm above the margin, and there is a crushed area on the unifacial edge near the step fractures where a blow has been struck. It appears that an attempt was made to remove the overhanging material which was inhibiting the sharpening of the tool; instead, the blow removed most of the bit. Given the presence of similar chipping material, petrified wood, in Layer IV-V, the eastern provenience of the single endscraper from Layer IV-V, and the casts of rodents burrows which could account for vertical movement in that area, it seems reasonable to presume that catno 958 is derived from Layer IV-V even though its matching piece(s) has not been found.

Chipped Stone Debris: Twenty pieces of chipped stone debris including a bipolar core (catno 963, XU 1, 3.5 g, petrified peat) were recovered from Interlayer V/VI. The total weight is 17 g. Materials range from chert (three pieces), to Knife River Flint (1), petrified peat (9), petrified wood (2), quartzite (1), quartz (1), Swan River Chert (2) and silicified sediment (1). The overall array is the same as for chipped stone debris from Layer IV-V, while the proportions are roughly similar to the smaller fraction of Layer IV-V chipping debris. Therefore it is likely that V/VI chipping debris is derived from Layer IV-V. A modest amount of rodent burrowing and trampling would account for their slight downward movement.

Faunal Remains: Bones from this interlayer deposit contributed to a radiocarbon sample (S-1761) selected from XUs 1 and 2. Only a handful of bone remains in the collection.

Rabbit or Hare, NISP=6 (1.8 g): thoracic vertebra, sacrum, ulna, ilium, calcaneus, navicular. All but the sacrum, from XU 2, were recovered from XU 1. The ilium was fractured when fresh and is pitted by digestion, but the other bones are complete and undigested. Only the sacrum exhibits rootlet etching.

Richardson's Ground Squirrel, NISP=1 (0.1 g): maxilla with all alveoli and containing P^4 and M^2. It was recovered from XU 1.

Unidentified mammal, n=60 (14.2 g): fragments less than 4 mm in length. Six digested specimens are scattered through all three units.

Snails: Two gastropods were recovered from XU 1.

Discussion: It is possible that most of the leporid and ground squirrel remains were derived from the (badger?) burrow encountered in Layer IV-V in adjacent XU 4 (see above). However, the rootlet-etched sacrum from XU 2 cannot have originated in the burrow, and it probably belongs with the leporid symphysis, scapula and 1st phalanx in Layer IV-V (see Table 9.6).

Chapter 10

Layer VI: An Avonlea Kitchen and Kiln

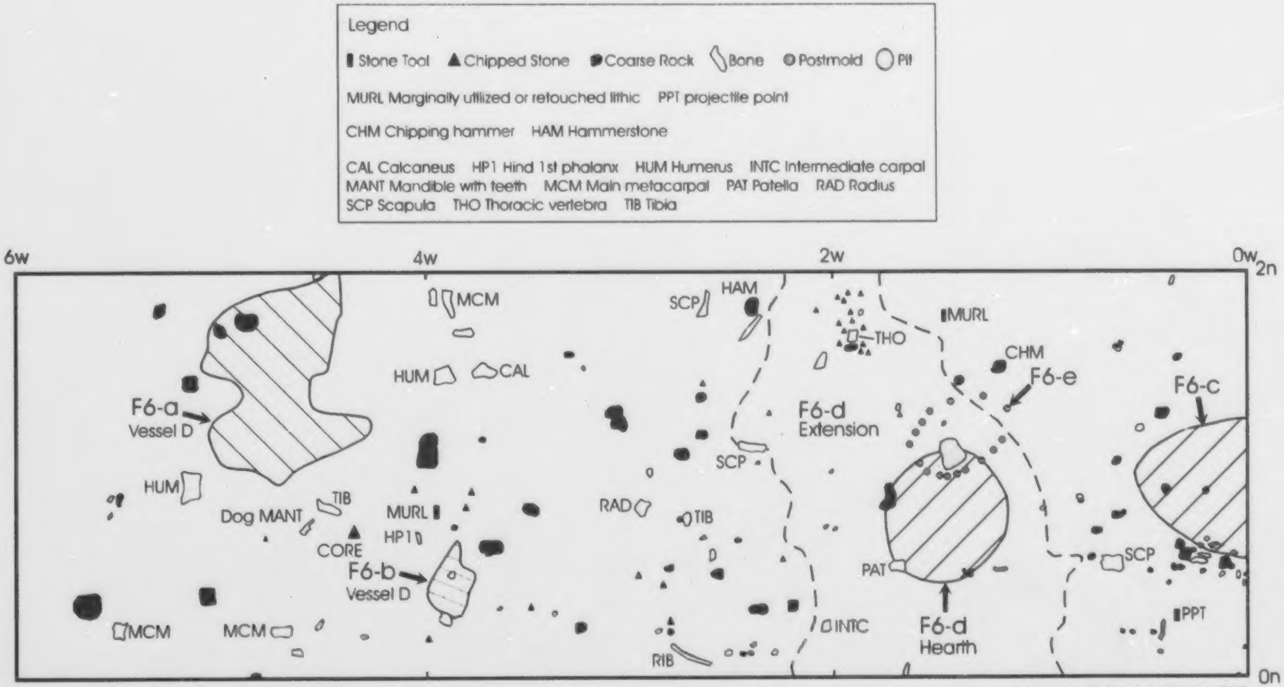
Introduction and Planview

Layer VI is situated 88-101 cm BS at 2n2w, coinciding with the base of a diffuse, intermittent grey-brown buried soil labelled Ahb4 and an underlying buff-grey, white speckled, sandy silt horizon labelled C5 (Table 3.2). Five features were found at the base of the Ahb4 horizon or, where the Ahb4 horizon was imperceptible, in positions extrapolated to be equivalent. Artifacts extended throughout the C5 horizon. From a high point at 2n0w to 0n0w the occupation surface was essentially flat, and from 0n0w to 1.75s0w it sloped downward (toward the creek) at a rate of about 21:175. Similarly, the surface was flat from 2n0w to 2n3w, and sloped downward from 2n3w to 2n6w at a rate of 25:270. Two radiocarbon dates on bone from Layer VI provided an age in the range of AD 550-750 (cal 1400-1200 BP; Table 3.6). The base of a loosely infilled, vertical animal burrow reached to the bottom of the Ahb4 soil horizon in the northeast corner of XU 4, and a smaller arterial burrow extended into the southeast corner of XU 1 (see also Chapter 9). An infilled, east-west oriented burrow, some 25 cm in diameter, extending from the top of Layer VI to the middle of Layer VII, was also in the northeast corner of XU 4. Interlayer VI/VII, about 13 cm in thickness, was comprised of buff/brown sandy silts. Layer VI and Interlayer VI/VII were excavated separately in XUs 1-3, but were removed as a single unit in XUs 4-6. All materials from the combination of VI and VI/VII in XUs 4-6 are included in the description of Layer VI. Artifacts from both Layers VI and VII were found in Interlayer VI/VII.

The Layer VI planview (Fig. 10.1) illustrates five aboriginal features and a fairly rich scatter of identified bones and stone tools. Among the stone tools are a chipping hammer, a hammerstone, two MURLs, and a projectile point. Except for a dog mandible, all of the identifiable piece-plotted bones represent bison.

Features

Feature F6-a (Figs. 10.1-10.2; Table 10.1) was a concentration of more than 300 potsherds, and almost as many crumbs, lying in an area about 100x75x2 cm. The sherds were grouped roughly in two layers. Those on the bottom were somewhat more tightly grouped than those in the upper layer. Most of the lower sherds lay with their interior side up. Sherds in the upper layer were about evenly split between up-facing and down-facing orientations. Some pieces lay in tight articulation with others, had obviously been broken *in situ*, and could be refitted with ease. Many sherds did not articulate with close neighbours but could be refitted with sherds found elsewhere in the feature. All of the sherds


Legend
Stone Tool
Chipped Stone
Coarse Rock
Bone
Postmold
Pit
MURL Marginally utilized or retouched lithic
PPT projectile point
CHM Chipping hammer
HAM Hammerstone
CAL Calcaneus
HP1 Hind 1st phalanx
HUM Humerus
INTC Intermediate carpal
MANT Mandible with teeth
MCM Main metacarpal
PAT Patella
RAD Radius
SCP Scapula
THO Thoracic vertebra
TIB Tibia
6w
4w
2w
0w
2n
0n
F6-a
Vessel D
F6-b
Vessel D
F6-c
F6-d
Extension
F6-d
Hearth
F6-e
MCM
HUM
CAL
SCP
HAM
THO
MURL
CHM
HUM
Dog MANT
TIB
MURL
HP1
CORE
RAD
TIB
SCP
PAT
INTC
RIB
MCM
MCM
SCP
PPT

Planview by ID, Corel rendition by REM

Figure 10.1. Planview of Sjovold Layer VI.

Table 10.1. Features in Layer VI.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F6-a	pottery cluster	145n472w	105	85	2
F6-b	pottery cluster	45n388w	37	24	1.5
F6-c	open kiln hearth	90n10w	>60	>50	2-12
F6-d	extended hearth	c.82n160w	>200	160	½-3
F6-e	hide-smoking pit	110n144w	15	13	>11

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

were similar in paste, temper, decoration, and thickness, supporting the inferences that the group belongs to a single vessel (vessel D) and that the pot suffered most of its breakage in feature F6-a.

There was little else within the F6-a pottery concentration except for a couple of chipped stone flakes, a piece of baked clay, two medium-size fragments of coarse rock and two bone fragments. On the peripheries were a few pieces of coarse rock and broken bone — a bison cow or calf distal humerus fragment 50 cm to the east, a canid mandible 25 cm to the south, a bison tibia shaft fragment 20 cm to the southeast, and a bison bull humerus fragment 10 cm to the southwest. There were also a few pieces of chipped stone debris (17 pieces weighing 7.6 g), and one MURL in the vicinity. Generally, the number of nearby artifacts was few except for a smaller group of potsherds, feature F6-b, about 50 cm to the southeast.

Feature F6-b consisted of 24 medium-size sherds and 22 smaller sherds and crumbs of the same type of pottery as found in F6-a. Except for four sherds on the margins, all sherds were lying interior side up. Most lay in articulation with one another with only a small amount of soil separating the articulating edges (see Fig. 10.3). In general the sherds were arrayed in one layer although some were tipped partly onto the tops of others. Several refits between sherds in F6-b and F6-a show that they were not only the same type of pottery, but also from the same vessel. Around F6-b there was a continuation of the same sparse scatter of broken bones, coarse rocks and chipped stone debris as was seen around F6-a.

The best explanation for features F6-a and F6-b seems to be that they were the remains of a single medium-size vessel that broke or was cracked during firing and was discarded nearly intact, but unused. Why else would there be a couple of small pieces of fired finishing waste among the remains? One can easily imagine such small pieces falling to the bottom during manufacture and being fired with the pot, but surely they would have been discarded if the pot had been used. F6-a contained the greater part of the pot lying with a nearly complete side facing down, sides collapsed in and a large part of the "upper side" missing. That missing part was found face down in feature F6-b. The fairly large areas of blackened interior surface and black encrustation on interior parts of the neck and rim must then be explained as consequences of the firing and not of use. If that interpretation is correct,

Figure 10.2. Two clusters of pottery, F6-a (bottom left) and F6-b (middle right) from vessel D. RSM #EiNs-4:79-136 CT.

then one wonders about the location of the firing site. A sherd (catno 1164, two matching pieces) of the same type of pottery was found in the center of F6-c which could have been where the firing took place.

Figure 10.3. Close-up of vessel D sherds in feature F6-b. RSM #EiNs-4:79-141 CT.

Feature F6-c, a surface hearth, was partly exposed on the east side of XU 1 (see Fig. 10.4). The core of the hearth was about 60 cm in diameter. Its surface consisted of a 1-2 cm thick layer of ashy brown/black soil containing only two artifacts, a piece of fire-cracked rock and a small potsherd from vessel D. Underlying the surface of the hearth was a 10 cm thick lens of black soil with an encompassing fringe of reddened soil. This indicates considerable heat in a reducing atmosphere. Although wood charcoal was found in another hearth (F6-d) in this occupation layer, we do not find charcoal chunks in F6-c. However, pieces of charcoal were found in the general vicinity and may have been derived from either hearth. No artifacts were recovered from the subsurface portion of F6-c. On the south edge was a small cluster of debris including fire-broken rock and broken bones. It was seated on a thin patch of grey-brown earth. Surrounding the hearth to a distance of 25-50 cm to the south, west and north, was a sparse apron of scattered remains containing coarse rock, bone, chipping debris, and an Avonlea projectile point. All of this was resting on or in a thin zone of mottled buff and grey-brown soil. The colour was indicative of a sparse admixture of combustion materials to the natural buff-grey surface soil. There was no blackened or reddened soil underlying the apron. At its west edge, the F6-c debris apron merged with the eastern margin of F6-d.

We suspect that the primary function of F6-c was the open firing of a ceramic vessel(s). Supporting evidence includes: (1) the presence of a sherd of vessel D pottery at the center of the hearth — the same pottery found in features F6-a and F6-b where the newly fired pot was discarded; (2) the hearth was not closely confined; its carbonized and ashy remains were spread up to 50 cm in all directions beyond the hearth perimeter. This could be due to many factors — wind dispersal, fuelling with "feeder" branches of wood that burned beyond the perimeter of the central fire; dispersal by human and/or animal traffic during or after occupation; or, more relevant here, the removal and

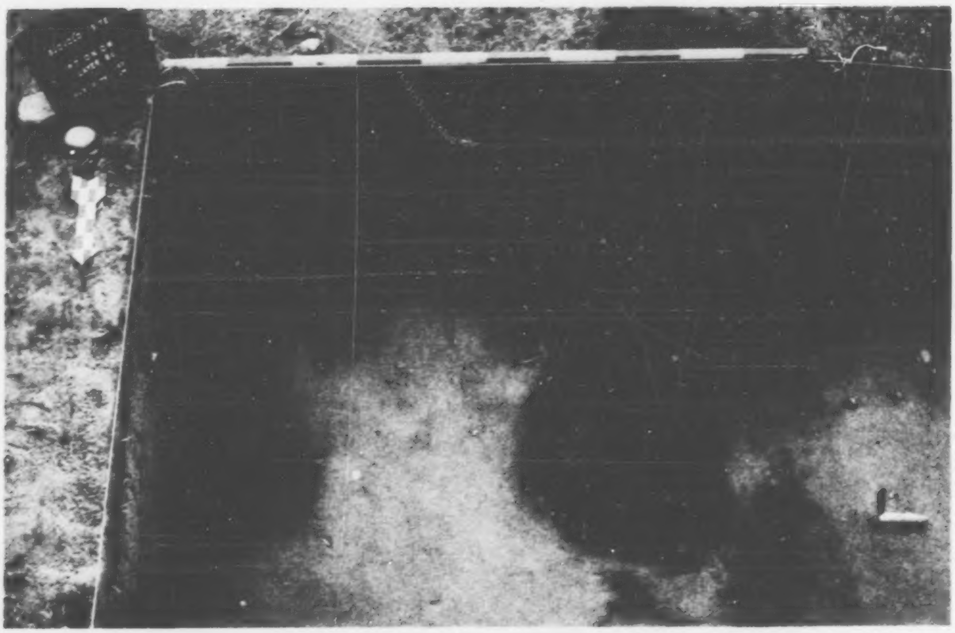


Figure 10.4. F6-d hearth (far right), F6-e pit and encircling postmolds (near right), and F6-c hearth (left). RSM #EiNs-4:79-149 CT.

dispersal of combustion materials which encased the pot(s) during firing; (3) the central part of the hearth was underlain by a thick blackened/reddened lens of soil indicative of great heat; (4) the close proximity a more extensive surface hearth (F6-d), apparently a contemporaneous feature, is puzzling unless one of the two had a special purpose. Use of F6-c as a surface kiln is such a special purpose.

Such an interpretation does not account for all the evidence in or on the peripheries of F6-c. The fragment of coarse rock may indicate that stones were used in the fire to support pottery as it was fired or to sustain the heat, or it may be a piece of debris from the larger hearth one meter to the west. The rock, chipping debris, projectile point, and bone fragments on the south margin, could mark an activity area where someone sat, just to the east of the large F6-d hearth, feeding himself and repointing an arrow. Such activity may have been unrelated to F6-c and may have occurred before or, more likely, after its use as a kiln.

Feature F6-d was an extensive surface hearth, most of which was exposed on the west side of XU 1 and the east side of XU 2 (see Fig. 10.4). It enveloped another feature, F6-e, which is described separately. F6-d consisted of a thin (0.5-1.0 cm) but extensive (160x>200 cm) surface layer of ashy brown/black soil that was centrally underlain, at about 95n160w, by a lens of black/brown and reddened soil measuring approximately 70 cm in diameter by 5 cm in depth. The subsurface lens marked the seat of the hearth and the center of the extended feature. The surface extension of combustion debris was most pronounced to the north where a thin increasingly narrow blackened surface continued past the limits of excavation. A diffuse zone of blackened soil was also found south of the hearth to the limit of XU 1. Extensions to east and west were much more limited giving an elongated north-south orientation to the whole feature. There was a small (20x15x0.5 cm) lens of reddish-buff subsurface discolouration at 160n155w which may represent the seat of a hot rock or, perhaps, another small hearth site. Within the northern part of the extended feature was a concentration of chipped stone debris. Throughout the rest of its surface was a sparse scattering of coarse rock and bone fragments with a few pieces of chipping debris. Bone, coarse rock fragments, chipping debris and chipped stone tools were found in somewhat greater densities along both west and east peripheries of the extended feature.

It appears that F6-d was an extensive medium to low intensity hearth. It did not burn as hot as F6-c, since its subsurface soil was not burned so deeply. Nevertheless, it supported a wider array of peripheral activities. Coarse rock was heated on the F6-d hearth. Bison meat and/or bones were prepared and consumed, the remains being discarded around the margins of the hearth. Stone tool manufacture or repair took place at the north end, and a variety of stone tools were used and/or discarded along the margins. After these uses the locality served another function that produced feature F6-e.

Feature F6-e consisted of a small, ashy-earth filled pit intruded into the central hearth of F6-d (see Figs. 10.1 and 10.4). In plan the pit had an irregular bulbous outline and measured about 15x13 cm. In profile it had roughly vertical edges and a very irregular three-pronged base. This made it look as if the pit had been dug by a long sharp object such as a digging stick or knife. The top of the pit was faintly evident at the uppermost elevation of the F6-d hearth. The pit's walls cut through the F6-d hearth, its jagged base reaching down an additional 5 cm below F6-d. Such intrusion clearly indicates that F6-e postdated F6-d, but not by much. An additional aspect of the feature was an encircling row of tiny post molds. Arcing around the pit and over the black face of F6-d were at least 6 thumb-size "post molds". Filled with yellow sandy-silt they stood out clearly against the hearth's black soil. Unfortunately, they were not recognized or sectioned during excavations, but they do survive, clearly, on colour photographs of the feature. Since the post molds appear both in the top and middle plans of the feature (there was no lower plan), we can estimate their depth to have been at least 2 cm. The arc created by these post molds was about 35-40 cm in diameter, and it was not perfectly centered on the pit. Instead, it passed between the pit (2 cm from the edge of the pit) and the center of the hearth. On the opposite side the postmolds were as much as 25-30 cm from the pit. Thus, the presence of a still hot or dirty hearth may have been a factor in the positioning of posts (withes) to avoid the center of the hearth.

A plausible function for feature F6-e is that of a hide-smoking pit (cf. Binford 1967 for ethnographic descriptions). Presumably the ash-filled pit generated smoke by means of an enclosed burning of fuel such as bison dung and/or rotten wood. The small post molds would represent places where saplings were shoved into the ground to create an encircling framework over which a hide could be suspended for smoking. The overall feature, and the pit in particular, was smaller, both in diameter and in depth, than the rough range established by Binford (1967) from several ethnographic descriptions. However, it is within the range of depth and diameter which seems to be emerging for archaeological examples (cf. Dyck 1977:171-177, 257-262).

Discussion: Layer VI features were grouped into two clusters, pottery to the west and hearths to the east. The pottery lay in an area where little other material was discarded, while the hearths, particularly F6-d, seem to have been foci of moderately intense fireside activities such as stone chipping, stone heating, food preparation and consumption, and hide smoking. The combination of a complex hearth grouping with a separate but adjoining pottery discard area is one which fits neither the floor size nor the configuration of most bison hunter dwellings. Such an arrangement seems more likely to have occurred in an outdoor kitchen/work area. The evidence for pottery manufacture is also a seasonal indicator. Since pottery manufacture is best suited to warm, dry weather and is almost precluded by cold, snowy weather (Arnold 1985:71, 97), Layer VI was probably occupied during a warm season.

Rock

Coarse rock seemed to be scattered fairly evenly throughout the excavated area of Layer VI (Table 10.2). Most of it shows distinct signs of prolonged or repeated exposure to fire (colour change, advanced disaggregation into blocky or granular pieces, and in some cases crazing and potlid fractures). We classify such pieces as fire-broken and imagine that they were the consequence of using rocks for heat transfer purposes such as stone-boiling fluids or as roasting props for objects set in the fire. Exceptions are mainly in the andesite, basalt and, to a lesser extent, quartzite material types which often show impact rather than heat fractures. For example, we recovered a couple of ad hoc andesite cobble tools (chipping hammer and anvil). It is probable that other cobbles of andesite and basalt were used during attempts to smash hard objects such as fine grained chipping materials. A few broken pieces of coarse rock have edges that could have been used for chopping or scraping, but we cannot see any compelling evidence that supports their classification as tools.

The predominant rock materials (by weight) are granite (24%), gneiss (20%), basalt (20%) and quartzite (16%). If basalt and andesite are removed from the calculations, in order to separate rocks not primarily used with fire, then percentages of remaining materials change to granite (31%), gneiss (26%), quartzite (21%) and sandstone (7%). These figures follow the same rank order as the natural abundance of these rock types on nearby valley slopes and river flats (Dyck 1990). Thus, all of the coarse rock found in Layer VI was probably collected locally. Pieces destined for the fire seem to have been selected randomly, while basalt and andesite were probably sought out and carried to the site in

Table 10.2. Coarse rock from Layer VI.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
andesite	16	21	1	7	6	3	54
basalt	8	12	-	2	3	2	27
gabbro	141	2	3	3	3	-	152
gneiss	10	4	1	8	9	8	40
granite	22	39	9	29	59	26	184
grano-gneiss	-	-	-	1	-	-	1
limestone	7	18	1	6	4	1	37
mudstone	2	-	-	2	-	9	13
pyroxene	-	-	-	-	1	-	1
quartzite	1	3	2	2	4	2	14
quartz	-	1	-	-	-	1	2
shale	-	-	-	-	2	-	2
sandstone	10	8	3	2	4	2	29
unidentified	-	2	1	-	3	3	9
Total	217	110	21	62	98	57	565
Weight							
andesite	65	143	281	32	21	52	594
basalt	227	968	-	79	364	900	2,538
gabbro	447	17	116	43	18	-	641
gneiss	587	44	2	164	1,177	608	2,582
granite	136	174	177	392	1,098	1,074	3,051
grano-gneiss	-	-	-	73	-	-	73
limestone	18	227	13	17	34	73	382
mudstone	4	-	-	1	-	38	43
pyroxene	-	-	-	-	61	-	61
quartzite	15	334	1,335	45	192	152	2,073
quartz	-	8	-	-	-	109	117
shale	-	-	-	-	1	-	1
sandstone	196	150	94	9	94	95	638
unidentified	-	4	*	-	2	119	125
Total	1,695	2,069	2,018	855	3,062	3,220	12,919

greater amounts for special uses.

Calculation of the average size of fire-broken rocks allows a crude measure of their degree of disaggregation and hence of use. The basalt and andesite components are removed from the calculation since they were used for other purposes. The average weight of the remaining pieces is 20.2 g, a size much below the overall Sjovold site average (159.8 g). From this we draw the inference that use of fired rocks in Layer VI was either more intense or more prolonged than usual. Given the variety of other remains in the layer it seems that time may have been the more important factor. Therefore, it is likely that the duration of occupation was at least several days.

Table 10.3. Layer VI potsherds by provenience and vessel.

Sherds	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
vessel D (pg)	1	43	735	-	-	2	781
vessel E (pg or p)	2	-	-	-	-	-	2
vessel F (kci)	-	-	-	126	2	-	128
baked clay	-	-	1	-	-	-	1
unclassified	1	-	-	-	-	4	5
Total	4	43	736	126	2	6	917
Weight							
vessel D (pg)	6.3	309.4	2985.4	-	-	1.9	3303.0
vessel E (pg or p)	3.6	-	-	-	-	-	3.6
vessel F (kci)	-	-	-	87.9	1.3	-	89.2
baked clay	-	-	0.8	-	-	-	0.8
unclassified	0.1	-	-	-	-	5.7	5.8
Total	10.0	309.4	2986.2	87.9	1.3	7.6	3402.4

Table 10.4. Layer VI potsherds by vessel and part.

Sherds	rim	neck	shldr	body	base	crumb	Total
vessel D (pg)	10	-	-	392	10	369	781
vessel E (pg or p)	-	-	-	1	-	1	2
vessel F (kci)	1	3	-	48	-	76	128
unclassified	-	-	-	2	-	3	5
Total	11	3	0	443	10	449	916

Pottery

There were 916 potsherds and one piece of untempered baked clay in Layer VI (Tables 10.3, 10.4). The sherds represent three vessels, one being of the parallel grooved type (pg), a second either of the parallel grooved type or plain surfaced (p), while the third was knotted cord impressed (kci).

Vessel D (parallel grooved) consists of some 781 sherds and crumbs with a combined weight of 3303 g. The dimensions of individual sherds range 3-75 mm in length, and 4-12 mm in thickness. The paste is fairly fine and compact, with a laminated appearance. Colour of sherd cores ranges through the same light brownish-grey to dark grey hues as interior and exterior surfaces, but is often toward the dark grey end of the range. Most sherds have a lighter coloured exterior skin or oxidation zone measuring 1-2 mm in thickness. Temper is primarily crushed granite (feldspar, quartz and mica), the pieces having angular edges and a size range of 1-5 mm (modal size about 2 mm). One crushed sherd had a temper to clay proportion (by weight) of 1:6 (i.e. 15% temper).

We were able to refit groups of sherds into fairly large body, rim and basal sections which seem to be parts a single medium-size vessel (see Fig. 10.5). However, the gentle curvatures of the walls and base defied our attempts at full fixed reconstruction. Nevertheless, we think our estimates of overall size and shape are close to correct. The estimates are based on projections from hand-held refits, with the refits being certain, but angles between sections being approximations. Accordingly, we have determined that the vessel was conoidal, at least 31.5 cm in height and about 26.5 cm in greatest diameter (see Fig. 10.6). Continuous reconstruction from lower body to rim reveals a gently dished and near vertical wall about 7 mm thick. The maximum depth of curvature for the longest body-rim section is about 22 mm, occurring roughly midway along a vertical distance of 220 mm. The mouth is about 245 mm in diameter, just a little less than the maximum diameter of the vessel. The base seems to have been gently rounded, about 10 mm thick, and was considerably smaller in diameter than the body. We were unable to reconstruct the curve between base and body.

Although we were unable to reassemble the whole pot we probably have most of the pieces. (The only parts known to be missing represent about 20% of the rim.) The larger reconstructed body/rim sections have a weight to surface area ratio of about 1.4 g per cm^2. For the whole vessel, including the base, the average would probably have been somewhat higher (say 1.5 g per cm^2). Using the estimated height and diameter of the vessel, we calculate a total (exterior) surface area of 2150 cm^2. Multiplying that figure by 1.5 g per cm^2 one arrives at an estimate of 3225 g as the weight for the whole vessel. The actual composite weight of collected vessel D sherds and crumbs amounts to 3303 g. Thus, we conclude that our estimates of height and girth are, indeed, close to correct, but perhaps slightly smaller than the true dimensions.

The most distinctive feature of vessel D is its exterior finish consisting of spiralling parallel grooves approximately 5 mm wide by 1 mm deep and 4 mm apart. These cover almost the whole vessel exterior, sloping downward, right to left, from rim to base. The apex of the base is smooth. Generally, the grooves are rounded and smooth with tiny lines parallel to the long axis inscribed in some areas. In places the bottoms of grooves seem almost flat while the sides are straight and out-flaring. The ridges between grooves are usually flat and smoothed or slightly rounded and smoothed. Although the grooves form continuous channels, these occasionally wobble, or become shallower or thinner as they reach certain narrow vertical zones. Thus, the method by which the impressions were made appears to have been by means of very careful applications of a thong-wrapped or peeled-twig-wrapped paddle.

The rim of vessel D is smooth with a flattened top and rounded corners, and is thickened on the inside, probably as a result of top flattening. The interior surface is generally smooth but undulates with shallow depressions indicative of paddle and anvil construction. A fragment of bison scapula found just southwest of F6-c may have served as the anvil. The conformation of a large segment of the smoothed and clay-impregnated border of the scapula perfectly matches the interior profiles of

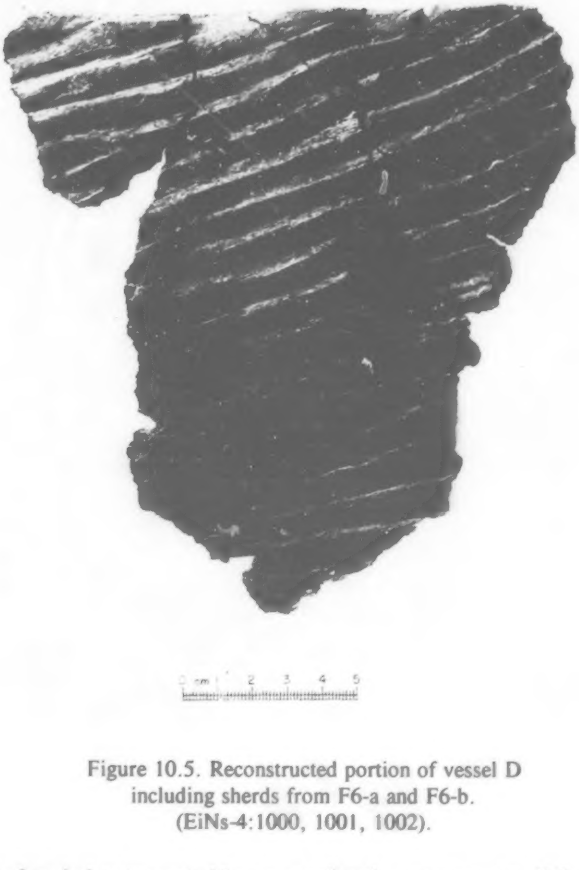


Figure 10.5. Reconstructed portion of vessel D including sherds from F6-a and F6-b. (EiNs-4:1000, 1001, 1002).

vessel D. Interior surface colour ranges from light brownish-grey (10YR 6/2) to very dark grey (10YR 3/1). Several sherds, some from the rim, have thin interior encrustations of black/brown material; most have none. The colour of the exterior surface ranges from light brownish-grey (10YR 6/2) to dark grey (10YR 4/1).

Comparisons: Vessel D belongs to the ceramic type known as parallel grooved (Fraley and Johnson 1981; A.M. Johnson 1988; see also Klimko and Hanna 1988) and conforms in shape, paste, colour, size, and decoration/finish to the characteristics of the type. In fact vessel D was taken into consideration when the type was defined. Ann Johnson (1988:139) has made a point about discontinuities in the parallel grooved decoration/finish, asserting that any particular groove is not continuous around the whole circumference of a vessel. Rather, it extends for a distance of 5-10 cm before being truncated by an overlapping groove at a slightly different angle. This assertion holds for the Layer VI vessel, although the matching of one piece of grooved pattern to another was so carefully done as to almost hide the breaks in groove continuity.

To date, the parallel grooved type is known only from the northern Plains, has been found only in association with Avonlea complex materials, and has been dated roughly to the period from AD 500 to AD 1000 (A.M. Johnson 1988:141). No antecedent type(s) has been identified, though Johnson (ibid.:140-141) suggests that a likely source area is the central midwestern United States. We agree and would add that there is some similarity in shape and finish between parallel grooved pottery and the Valley Cord Roughened type of Nebraska and Kansas (Kivett 1949; Wedel 1961:90, Plate V; Gunnerson 1987:44, Fig.7). The Valley Cord Roughened type is conoidal, with flattened or smooth rim, wall thickness of 7-9 mm, and long, rim to base cord impressions in diagonal, vertical or criss-

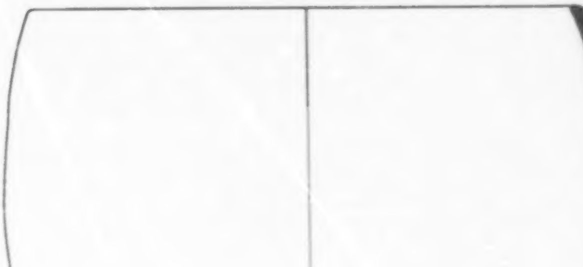


Figure 10.6. Schematic reconstruction of vessel D.

cross orientations. Aside from the thinness of the grooves left by cord impressions, the Valley type seems remarkably similar to the parallel grooved type. Benn (1983:79) has proposed that there are other ceramic types in neighbouring Iowa, the Dakotas and the Prairie Peninsula of Minnesota which might be grouped into the Valley ceramic series. He postulates that the "oriented cord roughening" which is so common in this series is a decorative treatment indigenous to the western prairies and plains, that it appears in Early Woodland Crawford and Fox ceramics, and that it continues to be a dominant feature of Middle and early Late Woodland ceramic complexes, particularly in the prairie lakes region of Western Minnesota. Thus, it would appear that there are some interesting comparisons yet to be made, and antecedents for the parallel grooved type may eventually be identified.

Vessel E (parallel grooved or plain) consists of one body or base sherd and one crumb weighing a total of 3.6 g. Both were found in XU 1. The body or base sherd (catno 1052) is 9 mm thick, with a smoothed interior surface which is light brownish-grey (2.5Y 6/2). The paste is yellowish-brown (10YR 5/4), laminated, and tempered with finely crushed angular or flat fragments (mostly 1-2 mm) of quartz, mica and white-grey feldspar. The small remnant of exterior surface appears to covered with a single broad, shallow groove. It is, however, a small surface area, and it is possible that the true surface finish was actually plain. The paste, temper and colour of the crumb (catno 1013) are the same as catno 1052. Both 1013 and 1052 are distinctly different in these characteristics from vessel D sherds. Consequently, we conclude that they represent a second parallel grooved or plain vessel, Vessel E.

Vessel F (knotted cord impressed). Some 128 crumbs and sherds of pottery belonging to vessel F are included with the record for Layer VI, all of it from the mixed Layer VI and Interlayer VI/VII materials recovered from XUs 4-6. No vessel F was pottery found in the carefully controlled sections of Layer VI or Layer VII. However, part of the pottery from this vessel was found in direct association with hearth F7-b in XU 6. Therefore, we infer that the source for all vessel F pottery was Layer VII and defer its description to that layer.

Baked clay. Two pieces of untempered baked clay were found in XU 3, one in Layer VI and another in the interlayer below. Catno 1035 from Layer VI is light yellowish-brown (10YR 6/4), 17 mm long, and weighs 0.8 g. The paste is slightly grainy, like the texture of silty clay, and very hard. The surface is quite irregular with tool facetting and with signs of having been broken while still wet — characteristics of a small piece of wastage from the finishing process of pottery manufacture. The material is similar in texture and colour to the clay portion of vessel D with which it was closely associated. Such waste clay may have lain within vessel D as it was fired.

Table 10.5. Stone tools from Layer VI.

Type	Catno	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
biface	2523	6	3.1	33	16	6	petrified peat	n	10.8d
chipping anvil	2464	5	498.1	113	61	47	andesite	y	10.7b
chipping hammer	996	1	104.4	71	30	33	andesite	y	10.7a
endscraper	1100	1	3.2	20	20	6	agate	y	10.8b
hammerstone	1148	2	200.6	77	59	55	sandstone	n	10.7c
MURL (3 pieces)	1098	1	3.5	32	25	4	chert	y	10.8f
MURL	1146	2	1.0	18	13	4	Knife River Flint	?	10.8e
MURL	986	3	4.0	26	21	6	Knife River Flint	y	10.8c
projectile point	1059	1	0.6	18	13	3	Swan River Chert	y	10.8a

Stone Tools

Biface (n=1). A small edge segment of a medium-size (oval?) biface was found in XU 6 (catno 2523; Table 10.5). Because of its provenience in a mixed level containing material from Layer VI and below, it is possible that the item is from the interlayer and, therefore, perhaps even from Layer VII. The bifacial chipping which formed the edge of catno 2523 extends 4-5 mm onto either face. The edge itself is sinuous and bears a slight use polish where not damaged. Parts of the edge have been subject to minor crushing which has somewhat dulled it. The segment was detached by a snapping fracture that started out perpendicular to one face, made a sudden rounded turn of 90° until it was almost parallel to the other face, then quickly feathered out. Presumably the biface was broken by using it with a twisting or levering motion.

Chipping anvil (n=1). Catno 2464 (see Fig. 10.7) is a medium-size, tear-drop shaped pebble with a generally smooth surface that has been roughened by incision/crushing in three small areas, two in the center of one face and one at the center of the opposing face. These roughened areas are fresh-looking. They range in area from 150-250 mm^2, have a maximum depth of about 1 mm, and consist of short overlapping incisions and pock marks. The incisions and pock marks tend to be concentrated and deeper toward the center or at one or more spots within the scarred areas. We interpret these areas as having been anvil seats where chipping materials were held and struck. The tool was found a short distance southwest of F6-d in an area where chipping debris was sparse.

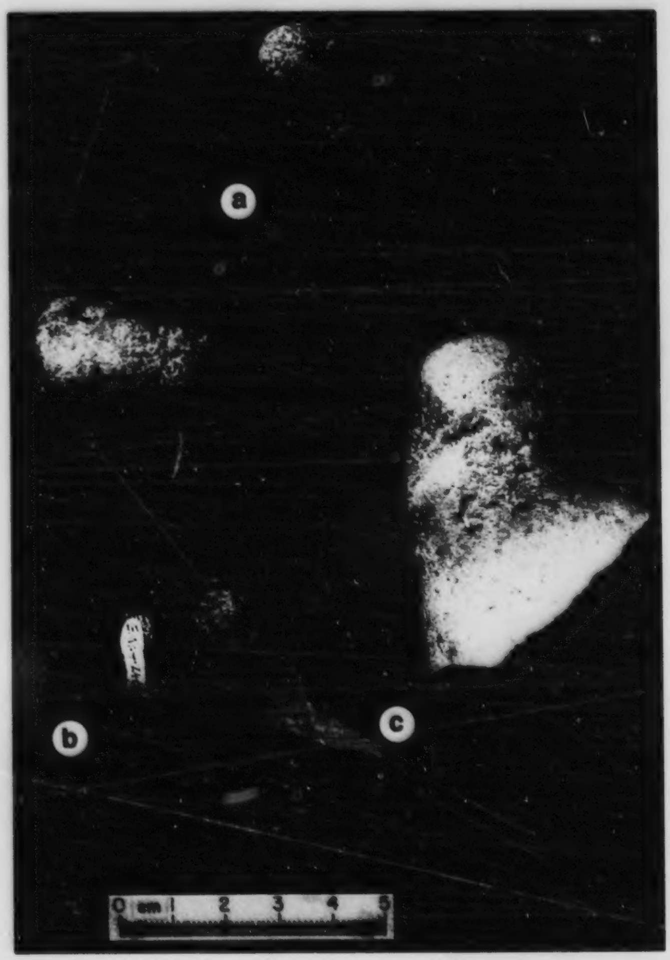


Figure 10.7. Pebble tools from Layer VI. a, chipping hammer; b, chipping anvil; c, hammerstone.

Chipping hammer (n=1). Catno 996 is an elongate pebble with a pecked and spalled area covering about 350 mm^2 at one corner of its fattest end. The pecking left overlapping pock marks in about one half of the area, the matching half having been subject to spalling with a few additional peck marks on its perimeter. Leading out of the pecked zone onto the adjoining side of the tool are a series of mainly parallel incised lines 3-11 mm long, each less than 0.5 mm wide and the same in depth. The pecked and spalled area was presumably the area which impacted the object material. The associated incisions may reflect use for edge dulling. The tool was found just outside the northeast edge of F6-d, near a concentration of chipping debris in the northern part of F6-d (Fig. 10.1).

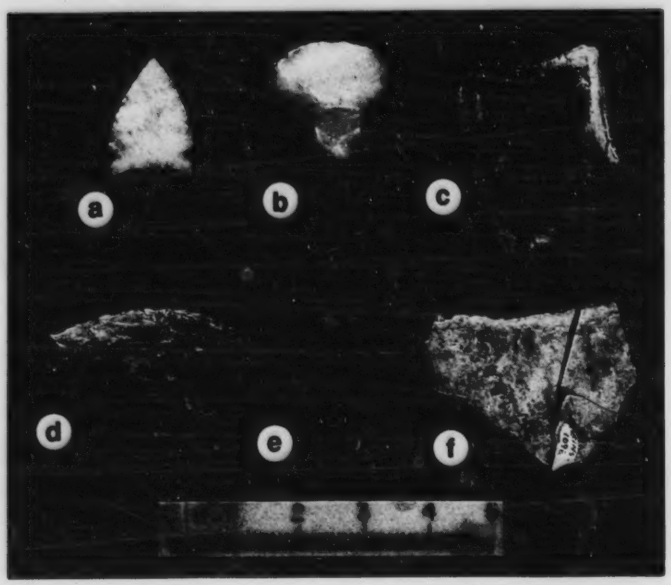


Figure 10.8. Chipped stone tools from Layer VI. a, projectile point; b, end scraper; c, e-f, MURLs; d, biface.

Endscraper (n=1). An exhausted triangular endscraper (catno 1100) was found in XU 1. It has steep dorsal retouching on all three sides, the distal end and one side having severe hinge fracturing just above their edges. Both side edges show light wear polish extending back onto the dorsal and ventral surfaces for about 0.5 mm. The distal edge shows much heavier wear and rounding except where an attempt at retouching left a series of hinge fractures.

Hammerstone (n=1). An end fragment (catno 1148) of a sandstone cobble is crushed and spalled on the apex. The crushing occupies a round area of about 450 mm^2. A single expanding flake scar about 18 mm wide and 19 mm deep runs down the side of the cobble from the crushed area. Since this damage could have been caused by a single blow, the hammerstone function must be recorded as equivocal. In any case, the tool was found just west of the concentration of chipping debris in the northern part of F6-d (Fig. 10.1).

MURLs (n=3). Catno 986 is a thick, dorsally ridged, slightly contracting flake with roughly parallel sides, both of which are unifacially retouched. One of the edges has a well worn (transversely) remnant at the distal end, but the rest of that edge is freshly retouched. It appears to have been used in a scraping motion. The other edge has only a few flakes removed from its central area and may not have been used. This tool may have been hafted by insertion into a socket seen in one end of a bison scapula fragment (catno 8098). The broad butt of the MURL can still be firmly seated into the socket, but one wall of the latter has been damaged by the collapse of cancellous tissue that might have failed during use of the scraper. A second MURL was refitted from three pieces (catnos 1098, 1129 and

Table 10.6. Chipped stone debris, excluding cores, from Layer VI.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
agate	2	-	-	-	-	1	3
chert	12	6	2	2	1	1	24
jasper	-	-	-	1	-	-	1
Knife River Flint	1	-	-	1	-	-	2
limestone	-	1	-	-	-	-	1
petrified peat	30	33	9	7	3	7	89
petrified wood	7	1	1	9	2	1	21
quartz porphyry	2	-	-	-	-	-	2
quartzite	1	15	1	2	-	2	21
quartz	-	-	2	2	-	1	5
Swan River Chert	8	9	3	6	-	1	27
silicified sediment	5	4	-	8	2	4	23
Total	68	69	18	38	8	18	219
Weight							
agate	0.5	-	-	-	-	7.0	7.5
chert	2.5	21.1	0.7	7.2	0.7	1.0	33.2
jasper	-	-	-	1.3	-	-	1.3
Knife River Flint	0.6	-	-	1.3	-	-	1.9
limestone	-	0.2	-	-	-	-	0.2
petrified peat	16.3	18.4	2.5	8.3	9.3	15.1	69.9
petrified wood	3.3	0.1	1.0	13.2	3.2	2.2	23.0
quartz porphyry	0.7	-	-	-	-	-	0.7
quartzite	25.7	25.6	0.8	1.0	-	29.2	82.3
quartz	-	-	1.0	18.1	-	0.8	19.9
Swan River Chert	12.5	3.0	2.2	5.6	-	3.0	26.3
silicified sediment	5.5	5.8	-	14.9	4.0	7.7	37.9
Total	67.6	74.2	8.2	70.9	17.2	66.0	304.1

1180) found in three successive excavation levels of XU 1 toward the bottom of Layer VI and just below. In Table 10.5 they are listed as catno 1129, the largest piece, but the size and weight in the table represent all three pieces. The reconstructed tool is made on the longest thickest edge of a thin decortication flake. The retouching is quite steep and covers three-quarters of the edge, a span of 21 mm. The edge is a mixture of fresh retouch scars and well worn, rounded edge remnants. Evidently, retouching of a use-worn edge has been attempted. It is difficult to see whether the wear is longitudinal or transverse, or to guess whether the tool was used for scraping or cutting. The main piece of this tool was found just outside the northeast edge of F6-d (Fig. 10.1). Catno 1146 is a thin broken flake derived from a bi-directional bipolar core. The flake scars creating the ventral face are oriented in one direction, while those of the ventral face have a perpendicular orientation. There is bifacial retouch or crushing along one edge. This MURL was found just north of F6-b (Fig. 10.1).

Table 10.7. Chipped stone cores from Layer VI.

Type	Catno	XU	Weight	Size*	Material	Fig.
bipolar	2438	5	2.9	a	chert	10.9c
bipolar	999	3	15.7	b	petrified peat	10.9i
bipolar	2372	4	2.6	a	silicified sediment	10.9g
bipolar	2347	4	31.2	c	petrified wood	10.9h
bipolar	2442	5	2.6	a	petrified peat	10.9b
bipolar	1108	2	2.7	a	Swan River Chert	10.9d
bipolar	2377	4	3.3	a	petrified peat	10.9f
bipolar	1111	1	2.1	a	silicified sediment	10.9a
bipolar	1113	1	5.4	b	quartz	10.9e

* size refers to categories based on greatest length: (a) 13-25mm, (b) 26-49 mm, (c) 50-100 mm, (d) 100-149 mm, and (e) 150 mm and larger.

Projectile point (n=1). Catno 1059 is a tiny, complete, well-formed projectile point of the Avonlea type (see Fig. 10.8). It was found on the southeast apron of F6-c, about 50 cm east of F6-d (Fig. 10.1). Near it were a few pieces of chipped stone debris. The notches are 3 mm wide, 1.5 mm deep and 2 mm above the base. The distance between notches is 11 mm. The basal edge is concave and smoothed from one side to the other. By its small size it seems almost certain that this point is an arrowhead. The Thomas (1978) discriminant classification equations for darts and arrowheads yield values of C_{dart} = 0.09 and C_{arrow} = 4.81 also indicating classification as an arrowhead.

Discussion: The stone tool assemblage from Layer VI was mainly around the peripheries of hearth F6-d. The assemblage reflects a variety of activities — manufacture and repair of stone tools (chipping hammer and anvil), fine cutting (MURLs), skin scraping (endscraper), and hunting (arrowhead) — all compatible with interpretation of F6-d as an outdoor kitchen hearth. This seems to be an adult tool kit, and probably mainly that of female adults, although the presence of a male is also indicated by the arrowhead. Despite the variety of tool types, and consequently of tasks performed, the number of tools for any particular type is very small. This combination suggests that only a few people, possibly members of one family, were responsible for the remains. The duration of their stay, though likely longer than a day, probably was not longer than a week.

Chipped Stone Debris

The Layer VI chipping debris (Tables 10.6, 10.7) is dominated by quartzite (27.1% by weight), petrified peat (23.0%), silicified sediment (12.5%) and chert (10.9%). The high percentages of quartzite and petrified peat suggest that local river valley sources were familiar and important to Layer VI occupants. The other dominant chipping materials could also be local. Swan River Chert, in such small quantities, is ambiguous as to source with possibilities stretching from local to east-central

Saskatchewan deposits. The Knife River Flint indicates commerce with North Dakota. The average weights of Knife River Flint, limestone, petrified peat, quartz porphyry and Swan River Chert show that these materials were reduced in a fashion that left small debris (<1.0 g per specimen); agate chert, jasper, petrified wood and silicified sediment left medium-size debris (1.0-2.9 g per specimen), while reduction of quartzite and quartz left the largest debris (3.0 g or greater). The overall diversity of materials and degrees of reduction suggest that a general purpose approach to chipped stone manufacturing and repair in Layer VI, as might be reflected in a leisurely family camping situation. All cores are of the bipolar variety, and all core materials are locally available (Fig. 10.9; Table 10.7).

The concentration of chipping materials in XUs 1 and 2 reflects a strong association with the features in that area and particularly with F6-d. Other concentrations in XUs 4 and 6 are ambiguous with respect to association, because the excavation method included materials from the interlayer below Layer VI. Nevertheless, when one compares the proportions of various kinds of materials found in XU 6, for example, with those in definite Layer VI proveniences in XUs 1 and 2, the similarities are quite obvious. In XUs 1 and 2 most stone chipping took place at northeast and southwest fireside positions. There are also strong similarities between chipped stone tools and the kinds of material found among the debris. All tool materials are represented by similar debris materials. The reverse, however, is not true, since most of the debris materials are not represented by tools. Thus, some of the tools made or repaired at this locality were moved elsewhere. The great majority of debris and tool material is locally available. That indicates that site occupants were both able and willing to use local chipping stone resources.

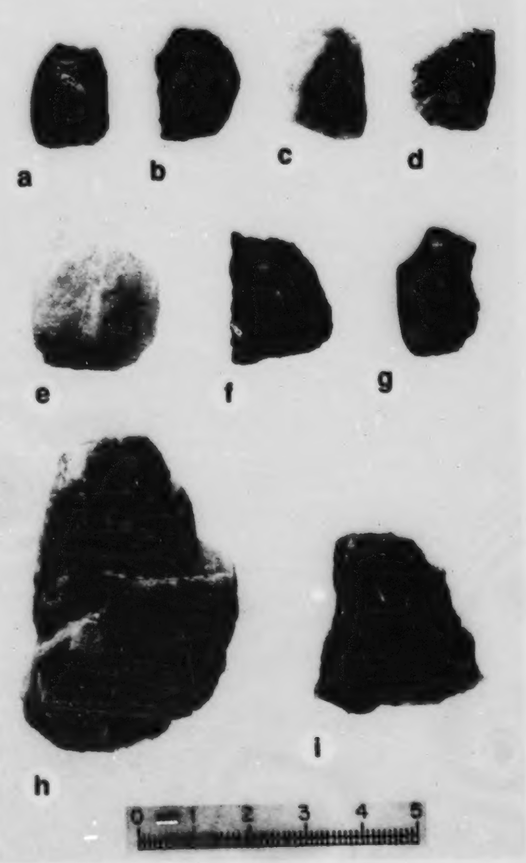


Figure 10.9. Chipped stone cores from Layer VI.

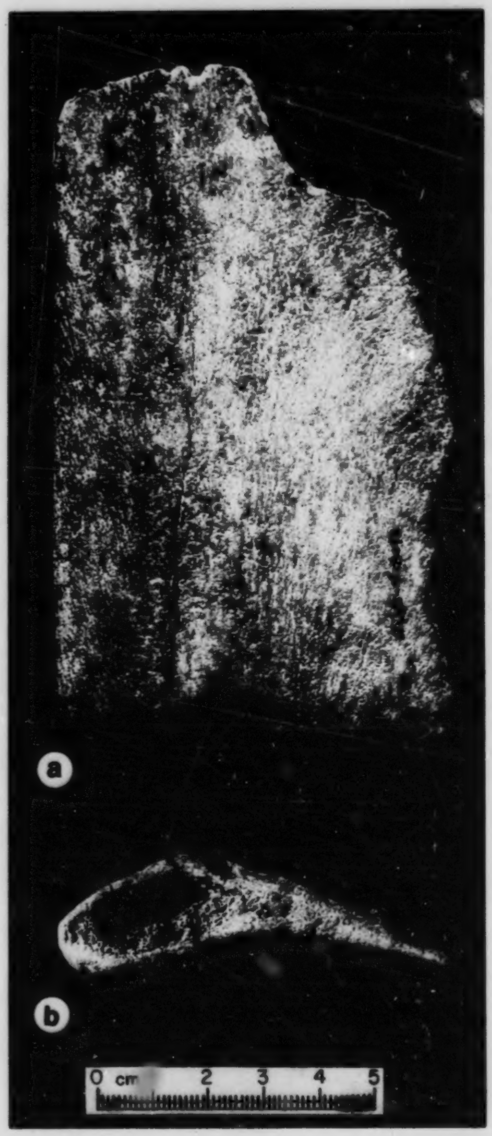


Figure 10.10. Bone handle? and potting tool? from Layer VI (EiNs-4: 8098). a, plan view; b, end socket for hafting MURL.

Bone Tools

A large mammal rib fragment with longitudinal striations is tentatively identified as a broken awl. It gradually tapers to a smaller cross-section that would soon reach a point, but both ends have been broken off. Found in XU 4 (catno 8095), the surviving portion is 61 mm long, and it exhibits local polish and longitudinal striations. A bison scapula fragment (catno 8098) may have served at least two tool functions (see Fig. 10.10). It is a 12.2 cm long segment of the inferior border very near the proximal end of the bone. The anatomically distal end of the fragment contains a socket formed by gouging out some of the cancellous tissue. The socket matches the size and conformation of the butt of a MURL (catno 986) that may have been hafted therein until use as a scraper caused surrounding cancellous tissue to collapse and dislodge the MURL. The scapula fragment may then have served as an anvil to fashion pottery vessel D. A slightly convex segment of the edge formed by the thinnest part of the scapula blade is smoothed to a contour that matches the interior of the vessel walls. This edge, and indeed most of the scapula fragment, appears to be impregnated with clay to a degree not seen on other bones from Layer VI. The location of the scapula only a few centimeters southwest of F6-c, where vessel D may have been fired, is consistent with this inferred function. It may also be noteworthy that the MURL was recovered from XU 3 where most of vessel D was found, for this implies a second linkage across the excavated area; however, the exact position of the MURL is unknown since it was recovered by screening.

Faunal Remains

Approximately 250 g of bone from XUs 1-3 were used for each of two radiocarbon dates (S-1762, S-1763) that demonstrate the contemporaneity of provisional sublayers VIa and VIb. Therefore only about 75% by weight of the recovered vertebrate remains are included in this analysis (Tables 10.8, 10.9).

Size 7 mammal, unidentified, n=1: rib(?). This is a very large bone that has been reconstructed by conjoining about a dozen fragments recovered from XU 6 (see Fig. 10.11). From the characteristics of the fracture surfaces and locally rounded edges, it appears that much of the fragmentation occurred during excavation and screening, and the specimen appears to be unusually brittle and susceptible to mechanical damage. The reconstructed bone resembles a rib shaft measuring 42.8 cm in length, averaging 5.6 cm in width (anterior-posterior), 3.6 cm in depth (medial-lateral), and weighing 371.2 g. The thickness of its cortical wall ranges from 0.76 to 1.92 cm. Comparable measurements for a bison rib are 3.3 cm in width, 1.6 cm in depth, and 0.17-0.58 cm cortical wall thickness. Thus the size and gentle curvature of the unidentified specimen immediately suggests a megamammal, and we initially assumed that it would prove to be a proboscidean rib that might have been quarried or eroded from nearby Pleistocene deposits and imported to the Sjovold site. However, proboscidean ribs differ in their cross-sectional orientation in that they are quite narrow in relation to their medial-lateral depth. The closest match we have found is the left 6th rib of the giant ground sloth, *Eremotherium*. Similarities include general size and conformation, very rugose vascular grooves along the anterior border, and a distinctive flattened area near the proximal end that accomodates movement of the scapula. The flattened area is marked by several small transverse ridges that appear to be sites of muscle attachment. Despite these close similarities we doubt that the Sjovold specimen is a ground sloth rib, because (1) it has a hollow medullary cavity that appears to be lined with normal endosteal bone; and (2) accelerator mass spectrometry dating yielded an age of 1840 ± 55 rcybp ($\delta^{13}C$ = −19.6‰). Ground sloth ribs are densely packed with cancellous tissue, and all genera of ground sloths are believed to have become extinct near the close of the last glacial period (Kurtén and Anderson 1980; Anderson 1984). Since the ^{13}C ratio is typical of a terrestrial mammal with a diet of C_3 plants (Chisholm 1989), it is very unlikely that this bone represents a sea mammal, and the hollow medullary cavity suggests that it is not a rib. Perhaps the specimen represents a grossly pathological condition, but it is difficult to explore that possibility so long as we are uncertain as to the anatomical element involved. Pathology might explain the peculiar porosity of the cortical walls and the very low specific gravity of the specimen (0.83 g/ml, compared to 1.17 g/ml for bison ribs from this site).

Bison, NISP=40: four tympanic bulla fragments, mandible fragment, dP^3 (AG C), M^1 (AG 6), 3rd cervical vertebra, thoracic centrum, six rib fragments, three scapula fragments, three distal humeri ♂ ♀/©, proximal radius ♂, intermediate carpal ♂, lateral half of metacarpal ♂, proximal metacarpal ♀/©, metacarpal shaft, front 2nd phalanx, acetabulum, patella, proximal tibia, three tibia shaft fragments, calcaneus ♂, two hind 1st phalanges ♂♂?, hind 2nd phalanx, 2nd phalanx proximal epiphysis, 3rd phalanx, distal sesamoid. Two 2nd phalanges with unfused epiphyses represent near-

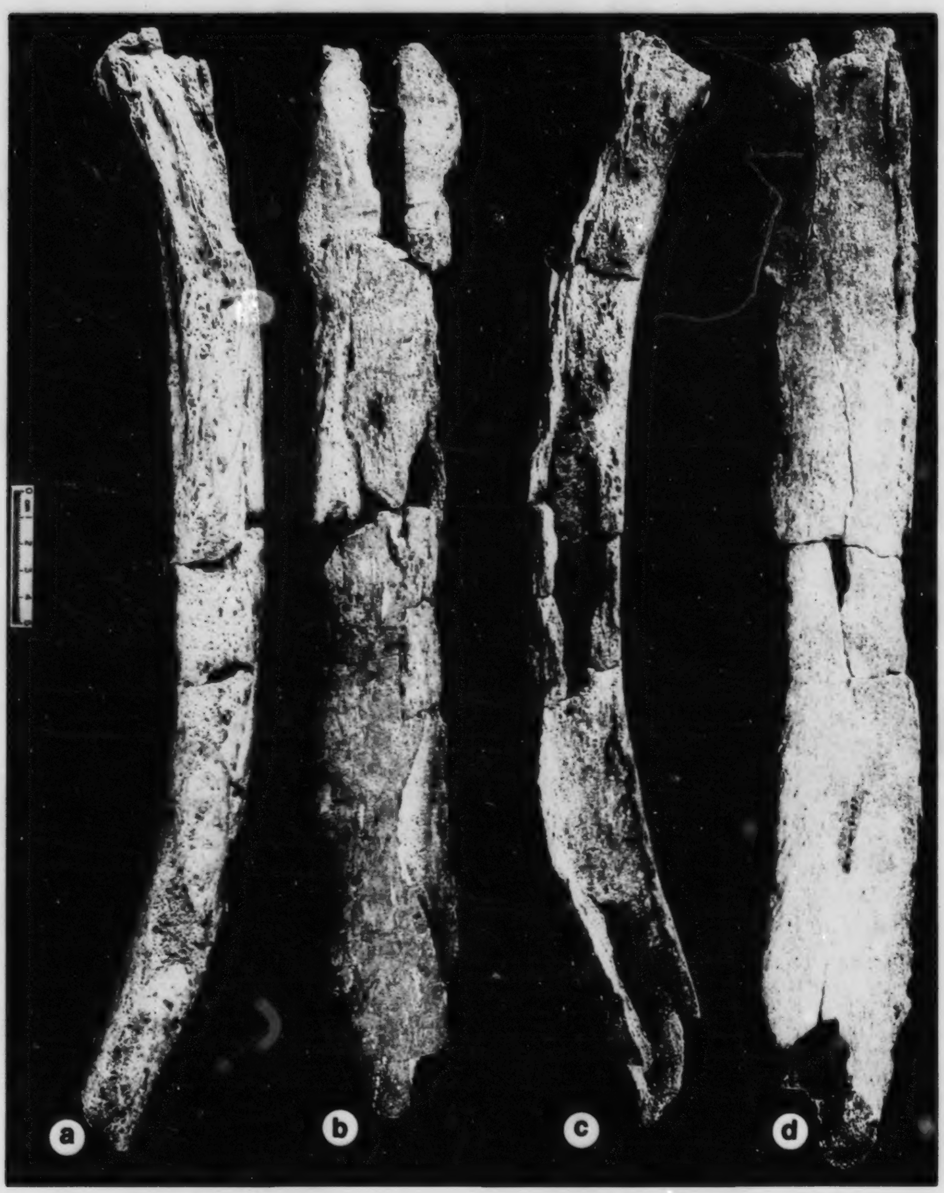


Figure 10.11. Unidentified megamammal rib? from Layer VI (EiNs-4:2486+2487+2993). Assuming a left rib: a, anterior; b, lateral; c, posterior; d, medial aspects.

Table 10.8. Vertebrate remains from Layer VI.[a]

Size, Taxon	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
7, mammal	-	-	-	-	-	1	1
6, Bison	4	12	4	2	10	8	40
5-6, mammal	7	14	6	16	18	5	66
4, Dog	-	2	1	-	-	-	3
3, Rabbit or Hare	4	1	-	*7	1	-	13
3, Cottontail	1	-	-	*5	-	-	6
3, Snowshoe Hare	-	-	-	*9	-	-	9
3, Jackrabbit	-	-	-	-	-	1	1
3, Fisher	-	-	-	-	1	-	1
3, mammal	14	5	1	-	2	5	27
2, Ground Squirrel	-	-	-	*4	-	-	4
-, mammal	263	199	167	179	141	146	1,095
Gull	-	-	-	1	-	-	1
Toad	1	-	-	-	-	-	1
unid. fish	1	-	-	-	-	-	1
Total	295	233	179	223	173	166	1,269
Weight							
7, mammal	-	-	-	-	-	371.2	371.2
6, Bison	158.4	604.7	256.9	109.7	300.8	429.1	1,859.6
5-6, mammal	17.4	138.1	12.9	136.4	162.5	31.6	498.9
4, Dog	-	2.5	36.7	-	-	-	39.2
3, Rabbit or Hare	1.0	0.3	-	1.9	0.1	-	3.3
3, Cottontail	0.4	-	-	3.5	-	-	3.9
3, Snowshoe Hare	-	-	-	9.6	-	-	9.6
3, Jackrabbit	-	-	-	-	-	0.6	0.6
3, Fisher	-	-	-	-	1.0	-	1.0
3, mammal	1.7	0.9	0.1	-	0.9	1.4	5.0
2, Ground Squirrel	-	-	-	0.8	-	-	0.8
-, mammal	102.5	77.4	51.9	121.3	70.1	70.3	493.5
Gull	-	-	-	0.6	-	-	0.6
Toad	0.1	-	-	-	-	-	0.1
Fish	0.1	-	-	-	-	-	0.1
Total	281.6	823.9	358.5	383.8	535.4	904.2	3,287.4

a. Superscripts (*) signify that all of these elements are thought to be intrusive into this layer. Two rabbit or hare and three muskrat bones were found in Test Profile No. 2 at depths correlated with this layer.

yearling calves, and the dP^3 is that of a calf near this age or slightly older. Since the cow or calf humerus and metacarpal are too large to be from a near-yearling, there are at least three bison age/gender groups represented by these 40 elements and fragments. Well preserved impact scars, indicative of fracturing for marrow retrieval, are seen on the medial side of a distal humerus, and on

Table 10.9. Modified vertebrate remains from Layer VI.[a]

Size, Taxon	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Fracture States Recent	Dry	Fresh	Whole	Total
7, mammal	-	-	-	-	1	-	-	-	1	-	-	1
6, Bison	1	-	5	-	6	30	2	2	12	18	6	40
5-6, mammal	2	1	-	-	*	*	6	-	21	39	-	66
4, Dog	-	-	-	-	2	3	1	-	1	-	1	3
3, Rabbit or Hare	-	1	1	2	-	6	-	-	1	6	8	15
3, Cottontail	-	-	-	-	-	1	-	-	-	1	5	6
3, Snowshoe Hare	-	-	-	-	-	-	-	-	1	-	8	9
3, Jackrabbit	-	-	-	-	-	1	-	-	-	1	-	1
3, Muskrat	-	-	-	-	-	1	-	-	-	1	2	3
3, Fisher	-	-	-	-	-	1	-	-	1	-	-	1
3, mammal	-	1	-	3	-	22	-	-	3	24	-	27
2, Ground squirrel	-	-	-	1	-	-	-	-	-	1	3	4
-, mammal	4	128	-	63	*	*	-	*	*	*	-	1,095
Gull	-	-	1	-	-	-	-	-	-	-	1	1
Toad	-	-	-	-	-	1	-	-	-	1	-	1
Fish	-	-	-	-	-	1	-	-	1	-	-	1

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

the posterior side of one tibia shaft. Another tibia shaft bears two impact scars on the anterior surface of the bone. Multiple transverse cut marks on the mandible fragment may be related to removal of the tongue. Furrowing by carnivores is represented on one rib, two distal humeri, the patella, and the 3rd phalanx. Relatively advanced weathering (Stage 2) is seen on the metacarpal shaft. Unlike the layers above this, rootlet etching is quite advanced, having reached a moderate stage of etching in ten cases.

Size 5-6 mammal, unidentified, n=66: one cranial, six tooth, 12 rib, one innominate, 46 long bone shaft fragments. Cut marks are seen on a long bone and a rib fragment, both from XU 4, and the rib fragment may have been used as an awl.

Dog, NISP=3: C^1, mandible with all alveoli and containing M_1, proximal metatarsal II. In overall length, the mandible is smaller than our reference dogs and matches one of the coyotes, but the height of the horizontal ramus behind M_1 and the height of the ascending ramus are larger than the coyotes and closest to the smaller dog. The spacing of the alveoli matches that of our smaller dog and is smaller than the coyotes, reflecting the tooth crowding typical of dogs. Other dog-like characteristics include the absence of P_1, marked convexity of the lower border, and a pronounced posterior deflection of the coronal apex (see Olsen 1985:19). The Sjovold mandible is smaller than the dog mandible reported from the Crown site (Quigg 1986:82-85). Wing's (1978) regression equation deriving body weight from mandible height behind M_1 yields a weight of 21.8 kg for the Sjovold dog and 25.6 kg for the one from the Crown site. Like the bison bones, the Sjovold mandible is weathered to Stage 1 and moderately etched.

Rabbit or Hare, NISP=15: edentulous maxilla, distal scapula, distal humerus, radius shaft, talus, distal metapodial, considered contemporaneous with Layer VI; rib, distal humerus, innominate, femoral trochanter epiphysis, talus, navicular, 2nd phalanx, considered intrusive into Layer VI; palatine, 4th cervical vertebra, found in Test Profile No. 2. A humerus, from XU 1, is charred, but the scapula is pitted and thinned by digestion. The elements considered to be intrusive were derived from the loosely infilled (badger?) burrow first encountered in Layer IV-V.

Nuttall's Cottontail?, NISP=6: scapula, two humeri, distal radius, radius, metatarsal II. Only the metatarsal, from XU 1, is thought to be contemporaneous with Layer VI. The other elements were derived from the loosely infilled burrow in XU 4.

Snowshoe Hare, NISP=9: skull missing only the occipital and containing all teeth except the I^2s, 5th, 6th and 7th cervical, 11th thoracic, broken thoracic, two lumbar vertebrae, metatarsal II. The skull is neither crushed nor filled with sediment, and its tooth rows precisely match those in the mandibles from XU 4 in Layer IV-V. Likewise the vertebrae, considered together with those from Layer IV-V, help to make up a nearly complete axial skeleton. These elements are distinctively stained and lack rootlet etching. They are thought to have originated in the loosely infilled burrow.

White-tailed Jackrabbit, NISP=1: ilium fragment. The presence of rootlet etching suggests that this element is contemporaneous with Layer VI.

Muskrat, NISP=3: distal humerus, radius, ulna. All were found in Test Profile No. 2.

Fisher, NISP=1: mandible with P_3-M_1 alveoli and containing P_4 and M_1.

Size 3 mammal, unidentified, n=27: vertebral centrum, two ribs, 24 long bone. One long bone from XU 1 is charred. The centrum and three long bone fragments show evidence of digestion. Many of these elements are of appropriate size for leporids, but they lack diagnostic attributes.

Richardson's Ground Squirrel, NISP=4: maxilla with all alveoli and containing P^4 and $M^{2\text{-}3}$, lumbar vertebra, two femora. The post-cranial elements can be identified only to genus, but all of these bones are thought to have been derived from the loosely infilled burrow in XU 4. A femoral distal epiphysis recovered in Layer IV-V has been refitted to a femur from Layer VI. The maxilla and teeth are smeared with fecal material.

Unidentified mammal, n=1095: fragments smaller than 4 cm in length. Four specimens from XU 1 exhibit multiple cut marks, and burned fragments (104 charred, 24 calcined) were found primarily in XUs 1 and 4 where they were associated with the extended surface hearth (F6-d). The 63 digested specimens have a fairly even distribution across the excavation area.

Gull, NISP=1: tarsometatarsus. Except for its missing proximal epiphysis, this element is complete and represents an immature individual of a large species. From its size, only two species are likely candidates — *L. californicus* (California Gull), which breeds in the study area, or *L. argentatus* (Herring Gull), which migrates through the area. Judging from specimens of known age in the Osteology Collections, Canadian Museum of Nature, this gull may have died as a large nestling nearly ready to fly. The proximal epiphysis of the tarsometatarsus is not fused in a seven week-old Herring Gull but is entirely fused in a 10 week-old fledgling. Likewise a series of large nestling Ring-billed Gulls exhibits a mixture of unfused and barely fused proximal tarsometatarsi. The Sjovold specimen is too large to represent a Ring-billed Gull and therefore is probably a nestling California Gull. This species lays eggs in Saskatchewan during the month of June (Bent 1921:132). Incubation requires 24-28 days, and maturation to flight capability takes another five weeks or so. Hence the Sjovold gull probably died in August, and the entire Layer VI bone assemblage may represent a summer season occupation. One small area on the bone shaft has been gnawed by a rodent.

Toad, NISP=1: tibiofibula. The degree of staining and rootlet etching on this bone suggests that it belongs with the rest of the fauna.

Fish, unidentified, n=1: unclassifiable fragment. The presence of rootlet etching on this fragment suggests that it is contemporaneous with the rest of the fauna.

Snail: One small gastropod was recovered from XU 4.

Freshwater clam: One pelecypod fragment was found in XU 3.

Plant remains: We collected charcoal samples from XU 1 (27 pieces, 2.3 g) and from XU 2 (18 pieces, 1.9 g). A small assemblage of noncarbonized seeds was recovered at this level from the burrow spanning Layers IV-VI.

Discussion: Portions of bison bull, adult-sized cow or calf, and near-yearling are represented among these remains. Evidence of tongue removal and marrow retrieval is seen on these bones. Charring on a leporid element, and on a Size 3 mammal bone that may represent a leporid, suggests that this group played a role in the human subsistence economy. The charred elements were found in XU 1 and were associated with Feature F6-d.

A moderate amount of carnivore activity is reflected in tooth marks and digested bone fragments, and scanty remains of a dog are present in the layer. Dogs are not expected to eat toads because of the unpalatable toxins released by the parotoid glands (Stebbins 1966:58). However, toad bones from the Tipperary Creek site near Saskatoon are smeared with fecal material indicative of ingestion by a carnivore (Morlan n.d.), and the Layer VI toad bone could have been introduced to the Sjovold site by a dog or other carnivore.

The fisher mandible could represent natural mortality, or, if related to the human occupation, it could have dietary, ornamental, or ritual significance. We favour the view that it is related to human activity, but it is difficult to decide its precise role. Harmon (1911:379) notes that the marten, and we presume also the fisher, "has a rank, disagreeable taste; and is, therefore seldom eaten." Lowie (1963:119) mentions the use of ermine skins fastened to clothing to signify brave deeds among the Blackfoot and the Crow; perhaps a fisher skin still containing the skull and mandible could have served such a purpose. Wright (1987:7) observes that some occurrences of mustelid skulls and mandibles suggest their use in medicine bundles. The recovery of an isolated mandible fragment may reflect some such non-dietary function.

If the gull bone represents a nestling, the bird probably died in August. This is consistent with the warm season implied by the toad bone, by evidence of pottery manufacture, and by the interpretation of an outdoor kitchen. The significance of the fish bone is not clear, but fishing is a well-documented subsistence pursuit at Avonlea sites in the parkland and the woodland (Smith 1986; Smith and Walker 1988; Tamplin 1977). Regardless of the exact role of each taxon in the subsistence economy, all of the bones are similarly preserved and are distinctive in having more extensive rootlet etching than seen on bones in overlying layers. This degree of etching may signify that the bones spent a relative lengthy period in the active layer of the soil before finally being more deeply buried.

Test Profile No. 2 yielded three muskrat bones in two places on the exposure. A complete, rootlet-etched ulna (0.92 m B.S.) may be contemporaneous with Layer VI but cannot be precisely related to the archaeological deposits. A fresh-fractured distal humerus and a complete radius (0.86 m B.S.) are correlated with Layer VI, but they exhibit a very light staining and may be intrusive into this position. The same profile also produced a leporid palatine at the 0.86 m level and a leporid 4th cervical vertebra at the 0.92 m level. The palatine has been etched by rootlets, and the vertebra exhibits carnivore tooth punctures.

Interpretation of Layer VI

Excavation of Layer VI revealed most of an outdoor kitchen/work area and its accompanying trash-disposal zone. The main features are (1) an extensive general purpose hearth; (2) a superimposed hide smoking pit; (3) a moderately dense concentration of cooking, manufacturing, and broken tool debris in and around the hearth; and (4) a separate open-fired pottery hearth one meter to the east of the general hearth. Occupation debris to the west of the kitchen/work area included a medium-size parallel grooved pot that appears to have been damaged during firing. At a minimum, the activities which occurred in the kitchen/work area were: (1) cooking of food (bone fragments, fire-broken rocks, hearth); (2) scraping of materials such as hides (endscraper); (3) fine cutting (MURLs) of such things as hides or sinew for thread; (4) chipped stone tool manufacture and repair (chipping hammer, anvil, chipping debris); (5) pounding (broken hammerstone) of hard objects such as bones for marrow or of granite rocks to make temper for pottery; and (6) firing of parallel grooved pottery (special hearth, fired but unused pot, fired untempered clay). One or more women were probably the major actors in this scene, but it is likely that a male hunter(s) was present in the encampment (arrowhead, bison bones).

The occupation occurred between AD 550-750 (cal 1400-1200 BP; Table 3.6). It was a warm season occupation lasting at least two days and possibly more. The resources used by site occupants were primarily local as shown by the use of local surface deposits of coarse rocks, and the overwhelming predominance of locally available chipping materials among debris and tools. Nevertheless, a trace of exotic material (Knife River Flint, and possibly also agate, jasper and Swan River Chert) is present among debitage and tools. It may indicate commerce with areas to the south (North Dakota, Montana) and east (east-central Saskatchewan) where such materials are more abundant.

The archaeological identity is the Avonlea complex as indicated by the distinctive arrowhead and the parallel grooved pottery. The site is situated well within the known Avonlea range, perhaps a little north of center. Subsistence depended primarily on bison, supplemented by leporids and, to stretch the evidence, birds and fish. A dog was present and, weighing about 22 kg, would have been useful for carrying a small pack or for pulling a travois. With only moderate evidence of carnivore gnawing on recovered vertebrate remains, the dog must have been fed elsewhere on the site.

It is interesting to speculate on the possible significance of the large rib-like bone recovered from XU 6. It may have been collected or acquired in trade as a curiosity or even as an object of presumed spiritual or medicinal significance. This idea is based on historical and ethnographic reports such as the observation by Schoolcraft (1852:175) that "The Indians say that large animals had existed once in that country, of which they have pieces of bones that they use for medicine." Similarly Kroeber (1907:438) reports:

> The bones of large mammals or reptiles, found especially on river-banks, and thought to be the bones of the hiintcăbiit or water-monsters, are frequently used by the Arapaho as ingredients of medicine, as well as for sucking out diseases, the porous bone being applied to sores or wounds.

Interlayer VI/VII

Only in XUs 1-3 was Interlayer VI/VII excavated as a separate unit. In XUs 4-6 the materials of Layer VI and Interlayer VI/VII were removed together and are included in the descriptions of Layer VI above.

Table 10.10. Coarse rock from Interlayer VI/VII.

	Number				Weight			
Material	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
amphibolite	-	2	-	2	-	6	-	6
andesite	2	-	-	2	249	-	-	249
basalt	1	-	-	1	8	-	-	8
gabbro	1	-	-	1	20	-	-	20
gneiss	-	6	-	6	-	25	-	25
granite	16	8	3	27	112	104	*	216
limestone	3	1	-	4	5	2	-	7
mudstone	-	4	-	4	-	50	-	50
quartzite	5	6	-	11	152	140	-	292
quartz	2	-	-	2	78	-	-	78
sandstone	2	1	3	6	9	211	5	225
unidentified	8	2	-	10	9	2	-	11
Total	40	30	6	76	642	540	5	1,187

Coarse Rock (Table 10.10): The types of rock are identical to those from Layer VI except for the addition of amphibolite. The average weight, at 15.6 g, is a bit smaller as might be expected for materials trampled below an occupation layer. However, proportions (by weight) are distinctly different; for example, quartzite is the leader in the interlayer, while granite, the Layer VI leader, has an interlayer proportion about 5% less than that of Layer VI. These differences probably indicate that the interlayer rock is derived from both Layer VI and Layer VII. Such mixture has been noted for other materials and is probably due partly to taphonomic processes and partly to placement of the excavation levels.

Pottery (Tables 10.11, 10.12): Some 43 sherds and crumbs of pottery and one piece of untempered baked clay were found in Interlayer VI/VII. The three pieces of vessel D are presumed to have been derived from the bottom of Layer VI, whereas the 38 crumbs and sherds of vessel F were probably skimmed from the top of Layer VII. Vessel F is described in the chapter on Layer VII. The single piece of untempered baked clay is presumed to belong to Layer VI since the only other such piece was found in Layer VI in the same excavation unit.

Stone Tools (Table 10.13)

Biface (n=1). Catno 1206 is part of a thin biface edge segment. It shows use wear and light crushing along a sinuous edge. Its curved fracture surface is indicative of a snapping break.

MURLs (n=3). Catno 1180 is a piece of a use-worn and retouched edge. It refits with two other pieces (catnos 1098 and 1129) making a single tool from the F6-d hearth area of Layer VI just above. Catno 1183 is a small thin parallel-sided flake with fine unifacial retouching/crushing along the

Table 10.11. Interlayer VI/VII potsherds by vessel and excavation unit.

	Number				Weight			
Sherds	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
vessel D (pg)	-	3	-	3	-	6.2	-	6.2
vessel F (kci)	38	-	-	38	21.3	-	-	21.3
baked clay	-	-	1	1	-	-	0.8	0.8
unclassified	2	-	-	2	0.6	-	-	0.6
Total	40	3	1	44	21.9	6.2	0.8	28.9

Table 10.12. Interlayer VI/VII potsherds by vessel and part.

Sherds	rim	neck	shldr	body	base	crumb	Total
vessel D (pg)	-	-	-	2	-	1	3
vessel F (kci)	-	-	-	9	-	29	38
unclassified	-	-	-	-	-	2	2
Total	0	0	0	11	0	32	43

Table 10.13. Stone tools from Interlayer VI/VII.

Type	Catno	XU	Weight	Length	Width	Thickness	Material	Whole
biface	1206	2	1.4	22	16	4	petrified peat	n
MURL	1180	1	0.9	18	12	3	chert	n
MURL	1183	1	0.4	16	5	2	Knife River Flint	n
MURL	1229	2	0.4	14	11	2	Knife River Flint	n

whole edge on both sides. Its distal end has snapped off. Light wear, restricted to the edges and extending very little onto the faces, suggests use for fine cutting. Catno 1229 is the end of a larger tool made on a thin flake. The tool has two nearly parallel opposing edges, each with fine unifacial retouching. The edges are slightly crushed and exhibit a light amount of wear, attributes which are consistent with use as a fine cutting tool. The material is very similar to that of catno 1183 from the same interlayer, but the two pieces do not fit together.

Chipped Stone Debris: One hundred and nineteen pieces of chipping debris and one core were found in Interlayer VI/VII for a total weight of 313.1 g. The bipolar core of chert (catno 1197) weighs 8.2 g and was found in XU 2. Other debris includes agate (5 pieces; average weight 0.08 g), chert (27; 1.60 g), petrified peat (69; 2.73 g), petrified wood (9; 1.07 g), quartzite (5; 4.38 g), Swan River Chert (1; 0.3 g) and silicified sediment (1; 0.38 g). Debitage was scattered a bit more densely in XUs 1 and 2, possibly indicating association with F6-d in Layer VI. The predominance of petrified peat,

Table 10.14. Vertebrate remains from Interlayer VI/VII.

	Number				Weight			
Size, Taxon	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
6, Bison	1	1	-	2	1.4	10.5	0.0	11.9
5-6, mammal	8	25	5	38	37.8	85.3	10.7	133.8
4, Dog	1	-	-	1	0.6	-	-	0.6
3, Rabbit or Hare	1	-	-	1	0.1	-	-	0.1
3, Skunk?	1	-	-	1	0.4	-	-	0.4
-, mammal	109	94	58	261	54.1	54.7	19.8	128.6
Total	121	120	63	304	94.4	150.5	30.5	275.4

Table 10.15. Modified vertebrate remains from Layer VI/VII.[a]

								Fracture States				
Size, Taxon	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	-	-	-	-	1	1	-	-	1	-	1	2
5-6, mammal	-	-	1	-	*	*	4	-	4	30	-	38
4, Dog	-	-	-	-	-	1	1	-	-	-	-	1
3, Rabbit or Hare	-	-	-	-	-	1	-	-	-	1	-	1
3, Skunk?	-	-	-	-	-	1	-	-	1	-	-	1
-, mammal	-	24	-	6	*	*	-	*	*	*	-	261

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

chert and quartzite is similar to proportions of those materials in Layer VI.

Faunal Remains (Tables 10.14, 10.15)

Bison, NISP=2: femur shaft, proximal lateral sesamoid. Both of these elements are from an extremely young individual, probably a near-term fetus that implies a late winter or early spring season of death. The femur is weathered to Stage 1, and the sesamoid is moderately etched by rootlets.

Size 5-6 mammal, unidentified, n=38: four tooth, 15 rib, one scapula. 18 long bone shaft fragments. A rib from XU 2 has been punctured by a carnivore tooth.

Dog, NISP=1: M_2. This tooth fits perfectly into the alveolus of the mandible in Layer VI.

Rabbit or Hare, NISP=1: distal metapodial.

Striped skunk?, NISP=1: proximal radius.

Unidentified mammal, n=261: fragments less than 4 cm in length. Burned fragments (22 charred, 2 calcined) were found in XU 1 where they were probably associated Feature F6-d in Layer VI. Six digested specimens were scattered across the excavated area.

Freshwater clam: Five pelecypod fragments were recovered from XUs 1 and 2.

Plant remains: We collected charcoal samples from XU 1 (20 pieces, 2.4 g) and from XU 4 (8, 1.4 g).

Discussion: The presence of fetal bison bone obviously implies that a cow was killed in late winter or early spring. This implies a different season from the scanty evidence for a summer occupation of Layer VI. On the other hand, the concentration of charred bone, probably related to F6-d in XU 1, suggests that at least some of the interlayer remains belong with Layer VI. Rootlet etching on the leporid bone suggests that it not intrusive. Layer VI contains contemporaneous leporid elements, but all leporids from Layer VII are considered to be intrusive. The canid M_2 belongs with the dog mandible in Layer VI; all canid teeth in Layer VII are from upper tooth rows. The provenience of the skunk radius is not clear, but it may well represent a supplement to the human diet. "Even when buffalo and other large game was most plentiful, skunk was most highly esteemed as an article of diet, and was considered specially beneficial to women in an interesting condition" (Dodge 1883:277; see also Macoun 1882:334).

Chapter 11

Layer VII: Samantha/Avonlea Domestic Chores

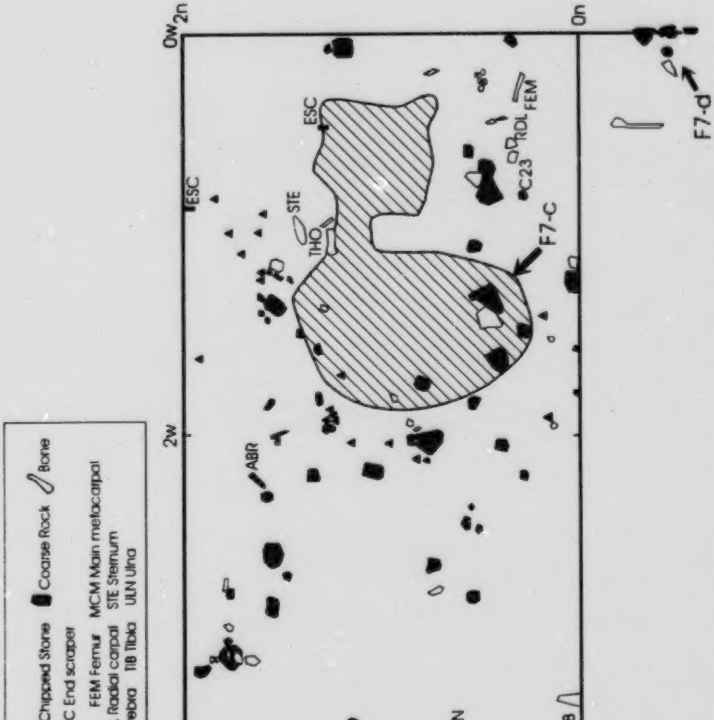
Introduction and Planview

Layer VII lies between 114-121 cm BS at 2n2w and coincides with two soil horizons — the intermittent dark-coloured Ahb5 and the underlying buff-coloured C6. Four features included two hearths, a rock-filled pit, and a rock cluster. A substantial amount of occupation debris was scattered through a vertical depth of about 7 cm, throughout the Ahb5 horizon and about the top 3 cm of C6 below. Archaeological identity is suspected to belong to an entity somehow intermediate between Avonlea and Besant, possibly somthing named Samantha (Kehoe 1974). The occupation surface slopes downward east to west across the excavated area at a rate of about 17:600. The north to south slope is downward at about 7:375. There was an infilled, apparently horizontal, east-west oriented animal burrow straddling Layers VI and VII in the northeast corner of XU 4. A radiocarbon date on bone indicates that occupation occurred between AD 150 and AD 650 (cal 1800-1300 BP; Table 3.6). Interlayer VII/VIII extends from about 121-124 cm BS at 2n2w. It coincides with buried soil horizon C7 and was roughly 3 cm in thickness throughout our exposure. Our excavations kept data for Layer VII and Interlayer VII/VIII separate in XUs 1-3, but combined them in XUs 4-6. The combined data are included with descriptions for Layer VII in this chapter. Care was taken to document the features and associated debris in XU's 4-6. Those records are the basis for our belief that the majority of mixed VII and VII/VIII materials in XUs 4-6 belong to Layer VII.

The planview reveals four features and a scatter of rocks, artifacts and bones (Fig. 11.1). Three piece-plotted stone tools include an abrader and two end scrapers. All identified piece-plotted bones represent bison.

Features

Feature F7-a (Figs. 11.1-11.2; Table 11.1) consisted of a shallow oval pit filled with fire-broken granite and gneiss rocks — nine pieces in the size range of 50-250 mm, together with several smaller pieces. The rocks lay one to one and a half courses deep with the highest parts to the outside so that there was a shallow cavity toward the center of the group. There were two bone fragments among the rocks. Enclosing soil was the buff-brown sandy silt typical of the natural deposit and much of the occupation surface of this layer. Similar soil filled the north half of the feature around the rocks, but the south half was filled with a black mottled soil. Some 50 cm southwest of F7-a was a small surface hearth, F7-b, whose elevation was equivalent to the highest point on the F7-a rocks. There was a sparse scatter of coarse rock, broken bones, the odd piece of chipping debris, and an occasional


Legend
Stone Tool
Chipped Stone
Coarse Rock
Bone
ABR Abrader
ESC End scraper
C23 Carpal 2+3
FEM Femur
MCM Main metacarpal
RAD Radius
RDL Radial carpal
STE Sternum
THO Thoracic vertebra
TIB Tibia
ULN Ulna
0w 2n
0n
2w
4w
6w
ESC
ESC
STE
THO
FEM
RDL
C23
F7-C
F7-d
ABR
ULN
TIB
MCM
RAD
F7-a
F7-b

Planview by ID. Corel rendition by REM

Figure 11.1. Planview of Sjovold Layer VII.

Figure 11.2. Close-up of rocks in feature F7-a. RSM #EiNs-4:79-158 CT.

Table 11.1. Features in Layer VII.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F7-a	rocks in a pit	18n500w	60	46	5-8
F7-b	surface hearth	24s588w	32	>25	1-5
F7-c	surface hearth	90n145w	108	63	0-2
F7-d	rock cluster	45s20e?	35?	?	6?

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

stone tool in the area surrounding F7-a with slightly denser amounts to the northwest and southwest.

Plausible functions include food roasting pit, stone boiling pit, steam pit of a sweat lodge, and shield-making pit. It is doubtful that F7-a was a sweat lodge rock pit for two reasons: the F7-b hearth was too close (50 cm); and the central cavity of the feature seems inappropriate. Deciding between food roasting and shield-making is also difficult. A small package of food could have been wrapped in a skin or some other covering, laid in the cavity surrounded by hot rocks, then covered to cook beneath "clean" earth from the north and charcoal-stained earth from the south. On the other hand,

Figure 11.3. Proximity of F7-b hearth (middle right) and F7-a rock pit in XU 6. RSM #EiNs-4:80-114 CT.

several attributes can be cited as support for a shield-making pit interpretation (see also Layer IV-V): the presence of males (projectile points beside the F7-b hearth); the availability of tools for hide preparation and cutting (endscrapers, abraders and MURLs) in the general vicinity; and the disposal of bison bones (a shield feast). As to the stone-boiling pit hypothesis, the small oval configuration of stones with a central cavity containing a couple of bone fragments is somewhat conformable to such an idea. It would require the stone-boiling vessel to have consisted of both subsurface and above-ground parts, a hide having been pushed into the pit and also propped above ground with sticks. Most of the subsurface capacity would have been used up by the stones. However, an above-ground portion of the vessel could have contained a substantial amount of fluid which could have been heated by hot stones dropped to the bottom. This idea seems possible, but improbable. In the end, we are not convinced by any of the hypothetical alternatives and must leave the interpretation of F7-a unresolved.

Feature F7-b was a small surface hearth marked by a circular patch of charcoal-rich earth centered at about 24s588w (see Fig. 11.3). Its diameter was 30 cm, and it was underlain by an irregular lens of blackened (burned and/or stained) earth 0-7 cm in thickness. The presence of both powdered charcoal and pieces of charcoal suggests that the principal fuel was wood. The surface of the hearth had been subject to moderate disturbance by a small animal whose horizontal burrows were filled with black/brown and, in places, yellow earth. Flecks of white calcium carbonate were evident

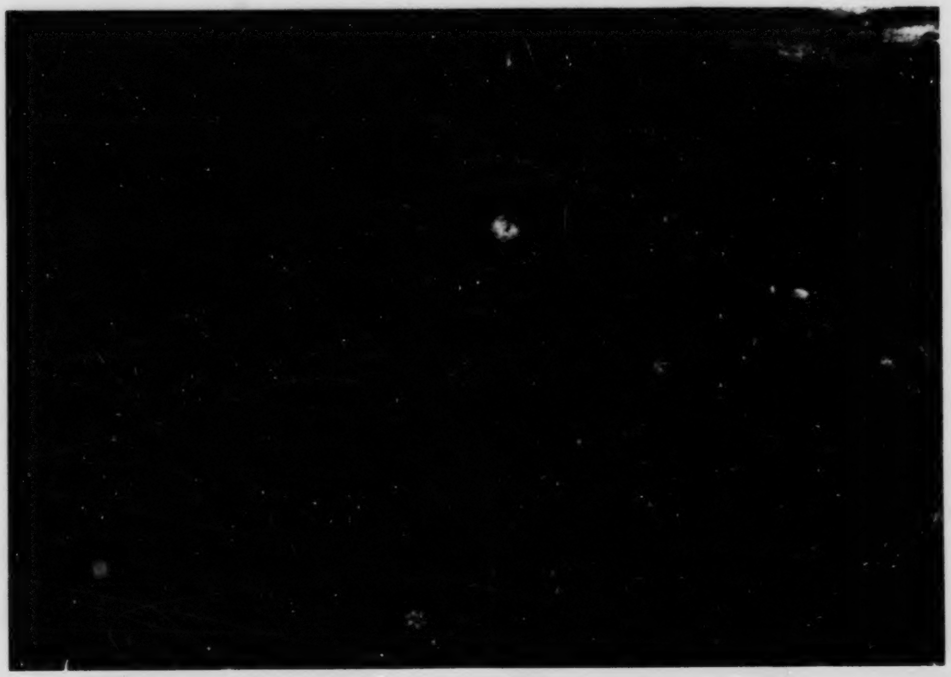


Figure 11.4. Hearth F7-c viewed from the north. RSM #EiNs-4:79-163 CT.

on the surface and throughout the substrate of the feature. Closely associated with the hearth were 17 small pieces of vessel F pottery and two projectile points. There were a few pieces of fire-cracked rock on the feature and in the immediate vicinity. Thus, the F7-b hearth was one place where the F7-a rocks could have been heated. It was obviously central to an activity area which, besides the hearth and rock pit, included a surrounding scatter of chipping debris, more stone tools, fire-broken rock and fragments of bone on a buff-coloured soil.

Feature F7-c was a medium-size surface hearth with some peculiar characteristics (see Fig. 11.4). The central area was void of archaeological remains except for a thin surface layer of mottled black/buff soil. Its perimeter was marked by an oval ring of ashy soil which was 6-10 cm in breadth, but less than 1 cm in thickness. On the southern part of the feature were three individual fire-broken rocks and a tight cluster of bone fragments surmounted by a pebble, all covered with a white film. Exterior surfaces of the bones were charred. Another tight cluster of bone fragments, on top of and surrounding a fist-size pebble, was situated a little more than 140 cm northwest of F7-c. Arcing around F7-c, to the south and west, was an area of blackened and ashy soil containing a sparse scatter of fire-broken rock, bone fragments, several stone tools, fragments of vessel F pottery, and a few

Table 11.2. Coarse rock from Layer VII.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
amphibolite	2	2	1	-	-	2	7
andesite	3	-	3	1	1	1	9
basalt	-	-	1	3	6	9	19
concretion	1	-	-	-	-	-	1
gneiss	4	3	20	4	4	5	40
granite	10	8	38	40	25	59	180
grano-gneiss	1	-	-	23	15	-	39
limestone	1	6	-	15	37	11	70
mudstone	4	1	-	-	3	-	8
pyroxene	-	-	19	-	-	-	19
quartzite	15	-	1	1	-	3	20
quartz	-	-	-	3	-	-	3
schist	-	-	-	-	-	9	9
slate	-	-	-	-	-	1	1
sandstone	3	1	13	5	10	6	38
silicified sediment	-	-	-	-	1	-	1
unidentified	-	1	3	6	26	27	63
Total	44	22	99	101	128	133	527
Weight							
amphibolite	203	160	*	-	-	1	364
andesite	16	-	5	2	2	1	26
basalt	-	-	16	12	119	16	163
concretion	*	-	-	-	-	-	0
gneiss	288	1,826	2,839	199	399	168	5,719
granite	1,529	643	246	1,887	1,434	1,240	6,979
grano-gneiss	756	-	-	5	12	-	773
limestone	804	359	-	69	71	47	1,350
mudstone	3	1	-	-	23	-	27
pyroxene	-	-	69	-	-	-	69
quartzite	371	-	61	17	-	370	819
quartz	-	-	-	17	-	-	17
schist	-	-	-	-	-	16	16
slate	-	-	-	-	-	3	3
sandstone	278	9	50	30	42	26	435
silicified sediment	-	-	-	-	*	-	0
unidentified	-	27	77	16	26	34	180
Total	4,248	3,025	3,363	2,254	2,128	1,922	16,940

pieces of chipping debris. This apron was a meter wide at its greatest western extent and reached about one third of the way to the F7-a rock pit. On the east side of F7-c there was an patch of charcoal-infused soil about 35 cm in diameter and 4-5 cm in depth. It was joined to F7-c by a narrow corridor of similar soil. The peculiar thing was that while F7-c had the central focus and the marginal fire-cracked rocks often seen on a hearth, plus a perimeter strongly demarcated by ash and an ash-infused fireside area, it had no underlying lens of burned or charcoal-infused earth. In fact, the centre of the feature contained only an intermittent skin of ash underlain by a very thin lens of mottled black-buff soil.

At first glance we were inclined to dismiss F7-c as being some kind of soil water residue shadowing the bottom of the Sjovold brothers' test pit some 45 cm above. However, when we matched the perimeters of the two features we found that the overlap was far from perfect. More importantly, there was no such shadow in the intervening F6-d hearth of Layer VI. Once it dawned on us that F7-c could not be related to soil water residues, we were free to search for other interpretations. The shape, size and most characteristics of F7-c were certainly like those of a hearth, with the exception of the missing subsurface lens of burned/stained soil. Fortunately, there is an experimental analogue, hearths fuelled by buffalo dung (chips). According to Wright (1986:290), the profile of a buffalo chip hearth "reveals a much shallower extent of heat penetration, more in the form of a rind as opposed to a symmetrical basin. Plan views of the hearth reveal a patchwork of differential heat penetration suggesting that the insulating effects of the ash residue may be involved in the production of this pattern." This description fits our observations for F7-c.

Thus, our interpretation is that F7-c was a buffalo chip hearth, and it would appear that its missing central ash could have been blown by wind over the activity area immediately west and south, or dragged from the hearth by people removing heated rocks from the fire. In addition, the ash may have been partly removed by our excavations before we recorded the feature. F7-c was probably situated out-of-doors, since chip hearths burn best with a breeze, and produce large amounts of smoke inside an enclosure (Wright 1986). Heating of coarse rocks was apparently one purpose for F7-c, but bone breaking, cooking, (hide) scraping, abrading and cutting also took place around it. The small charcoal-like smear adjoining the east edge of F7-c may have been an extension of the main hearth in which some wood was used as fuel and around which bone breaking and perhaps also meat consumption took place.

Feature F7-d was a tight surface cluster of medium to small fragments of fire-broken rock situated some 1.4 m southeast of hearth F7-c. We exposed only the westernmost part and left the balance buried intact beyond the limits of our excavations. With so little information at hand, it would seem best to forego an interpretation of this feature.

Rock

Predominant rock materials (by weight; Table 11.2) are gneiss (38%), granite (37%), limestone (9%), basalt (8%) and quartzite (4%). Almost all the gneiss and granite show signs of having been fired; about half of the limestone and quartzite shows the colour changes and/or irregular fractures which we interpret as due to firing. The basalt is ambiguous with respect to firing, but several pieces have been coarsely chipped. Perhaps some basalt was used to make tools that were not recovered. Coarse rock is fairly evenly spread through the exposure with a peak in XU 3 due to the rock in F7-a. Average size is 32.1 g per specimen, well below the site average (157.2), but about 50% greater than that for Layer VI. Granite and gneiss appear in almost exactly the same proportion in Layer VII as granite, gneiss and granogneiss in nearby surface sources (Dyck 1990). The same can be said for limestone and quartzite, especially if both coarse and chipped varieties of quartzite are combined. Basalt is in greater proportion than in local sources, suggesting selection for basalt. Sandstone is present only in tiny proportions both in the site and in local sources.

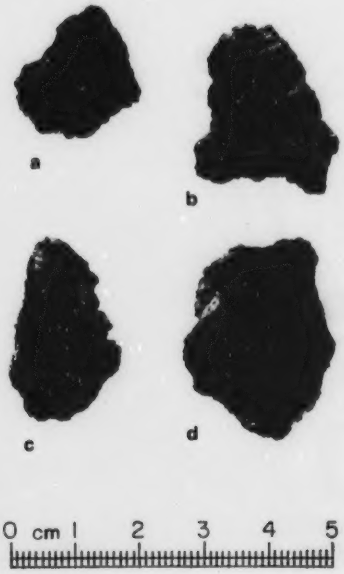


Figure 11.5. Vessel F sherds from Layer VII. a, EiNs-4:2763; b-d, 2407.

Pottery

Vessel D (parallel grooved). Two pieces of parallel grooved pottery were found in Layer VII (Tables 11.3-11.4). They are similar in respect to paste, colour, thickness and surface treatment to sherds of vessel D from Layer VI. Both sherds were recovered in XU 3, the same excavation unit that contained the concentration of vessel D sherds in Layer VI. Animal burrowing, which carried vessel D from Layer VI upward to Layer III, is presumed to be the same mechanism by which these sherds were intruded downward into Layer VII.

Vessel F (knotted cord impressed). The bulk of vessel F pottery was recovered from mixed Interlayer VI/VII context, but we did find 8 sherds and 9 crumbs in direct association with hearth F7-b in XU 6. We conclude that vessel F pottery was originally in or on Layer VII and that our excavation methods are responsible for the mixing. Consequently, we have assembled all the sherds for discussion in this section (see Table 11.5).

The dimensions of individual vessel F sherds range from 3-30 mm in length and 5-8 mm in thickness (see Fig. 11.5). The paste is fine and friable. A laminated appearance suggests that a paddle and anvil technique was involved in forming the pot. The colour of sherd cores ranges from dark greyish-brown (10YR 4/2) to black (5YR 2/1). Temper includes quartz, feldspar and mica in angular and subangular fragments 0.5-5.0 mm in diameter, a combination which suggests that crushed granite was the source. The glint of tiny pieces of temper is visible on both exterior and interior surfaces. The interior surface is smoothed and much of it is coated with a thin crust of carbonized material. Where

Table 11.3. Layer VII potsherds by vessel and excavation unit.

Sherds	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
vessel D (pg)	-	-	2	-	-		2
vessel F (kci)	-	-	-	1	-	17	18
unclassified	-	-	-	-	1	7	8
Total	0	0	2	1	1	24	28
Weight							
vessel D (pg)	-	-	14.9	-	-	-	14.9
vessel F (kci)	-	-	-	0.5	-	18.3	18.8
unclassified	-	-	-	-	0.3	1.5	1.8
Total	0.0	0.0	14.9	0.5	0.3	19.8	35.5

Table 11.4. Layer VII potsherds by vessel and part.

Sherds	rim	neck	shldr	body	base	crumb	Total
vessel D	-	-	-	2	-	-	2
vessel F	-	-	-	9	-	9	18
unclassified	-	-	-	2	-	6	7
Total	0	0	0	15	0	15	28

Table 11.5. Comprehensive inventory of Vessel F sherds by provenience and part.

Sherds	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
rim	-	-	-	1	-	-	1
neck	-	-	3	-	-	-	3
body	9	-	-	49	1	8	67
crumb	29	-	-	74	2	9	114
Total	38	0	3	124	3	17	185
Weight							
rim	-	-	-	0.4	-	-	0.4
neck	-	-	-	12.0	-	-	12.0
body	9.9	-	-	54.1	1.2	13.7	78.9
crumb	11.4	-	-	21.9	1.3	4.6	39.2
Total	21.3	0.0	0.0	88.4	2.5	18.3	130.5

sherds are not so encrusted, their colour is very dark grey (10YR 3/1).

Given the small size and number of sherds recovered, reconstruction of the whole vessel is not possible and overall shape remains unknown. Nevertheless, rim, body and neck sherds reveal some important aspects of shape and finish. The single rim sherd is only 7.5 mm long. It is smooth, rounded, 1-2 mm thinner than the walls, and appears to have been attached to a vertical neck. The exterior neck and body surface was smoothed, impressed with a cord or fabric which left rough shallow pock marks of irregular shape and size; then these impressions were slightly smoothed. It appears that the impressions are organized in a somewhat parallel alignment. Since all sherd exteriors show the pocked impressions, we conclude that the whole exterior, from rim to at least mid-body, was covered by them. No definite basal sherds have been identified.

There are single punctates on the exteriors of three sherds. Each is 5.5 mm in diameter, 3.2 mm deep, and has been impressed perpendicular to the surface by a pointed cylindrical object having a flat nose 2 mm in diameter. Each punctate is also matched by a very slight dome on the interior surface. We presume that the punctations are decorative and formed an intermittent row parallel to and a short distance below the rim. On many sherds, especially those found in the southern parts of hearth feature F7-c, the surface impressions are filled with a black substance, presumably carbonization due to disposal in the hearth.

Comparisons: Other examples of such knotted cord impressed pottery have been found at 14 Avonlea components in Saskatchewan, Alberta, Montana and possibly two sites in North Dakota (cf. Quigg 1988a:150). Their surface finish/decoration has been referred to as "fabric impressed," "knotted cord impressed," "net impressed" or "textile impressed" with some variants being referred to as "cord wrapped paddle impressed" (Wettlaufer 1960:39; Byrne 1973:355; Morgan 1979:348; Meyer, et al. 1988:35; Quigg 1988b). We find it difficult to recognize a diamond or square (net or textile) pattern on the Sjovold vessel F specimens, although it appears that there was some alignment within the field of impressions. It seems to us that the impressions on vessel F could be due to the rolling of a complex cord over the exterior surface, an action which could leave a "field" of pock marks of irregular shape and size, somewhat aligned in parallel rows and somewhat interconnected. A generally similar example is that illustrated by Hurley (1979:65) for his cord number 158. We prefer Quigg's "knotted cord impression" as the term which comes closest to encompassing all the methods by which these impressions may have been made.

The thinned, smooth, rounded rim of vessel F is within the range of rim types known for Avonlea knotted cord impressed pottery. Morgan (1979:202) reanalysed the Long Creek Avonlea material and found that the "net-impressed" rim sherds are of two types: (1) flattened and thickened; and (2) contracting towards a rounded lip. The vessel F rim belongs to the contracting type. That type also is present in the Garratt site Avonlea sample (Morgan 1979:350-353). The vessel F punctate impressions are similar to punctates on Avonlea vessels in the Garratt site. Morgan (1979:349) thinks that they were made with a hollow circular tool such as a feather shaft or bird bone shaft. Vessel F punctations with their bevelled sides and flat ends could very well have been made with a feather shaft. A final note of comparison is the hardness of the clay portion of the paste. For both vessel F and similarly finished vessels at the Garratt site (Morgan 1979:35) the paste is friable or crumbly. Compared to vessel D in the Avonlea component above, the paste of vessel F is definitely softer. One wonders what causes this difference, how general it is, and if it signals a difference in function for the two kinds of pots — problems which are beyond the scope of this study. The age of Layer VII, AD 150-650, places this pottery in the first half of the Avonlea complex. Vessel F is also the oldest clay vessel encountered at the Sjovold site.

Stone Tools

Sixteen stone tools were recovered within XUs 1-6, and one more was found beyond the southwest corner of XU 6 (Table 11.6).

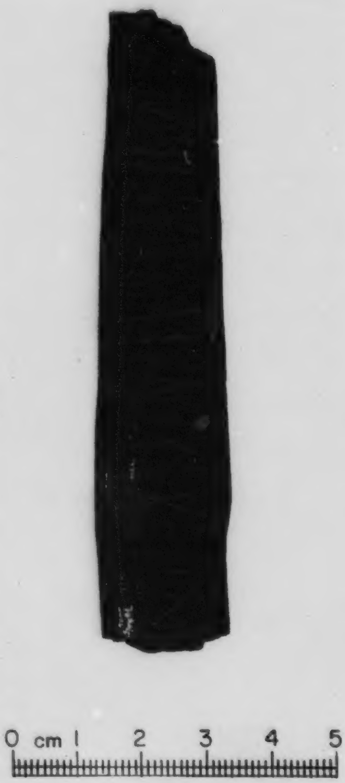


Figure 11.6. Bar abrader, Layer VII.

Bar abrader (n=1). Catno 1280 is a natural bar or rod of andesite with a rounded wedge-shaped cross section (see Fig. 11.6). It has a high degree of polished and incised rounding along its most acute longitudinal ridge. There are lesser degrees of polish and incision on adjoining flat faces leading to that ridge. The polish is again quite noticeable on the far edges of the same faces — at their junctures with the curved or rounded third face of the object. The rounded surface also bears incisions and polish but less than other parts of the tool. Both ends are broken transversely leaving a combination of shear and ragged end fractures. On the smaller end, polish from the ridges wraps over some parts of the fracture edge indicating that use occurred or continued irrespective of the breakage. Wear and polish on the other end is much less pronounced, almost absent. Under low oblique light, parallel diagonal incisions can be seen along the polished ridges, extending across the faces of the tool. In some cases, incisions have almost been worn away by polishing; in others they are fresh.

Catno 1280 has the use characteristics of a hand-held abrader on which the highly polished longitudinal ridge was used as the usual leading edge. That edge, and one or the other of the adjoining faces, was pushed diagonally across a broad flat surface that was supported yet yielding — a surface such as the inside or outside of a pliable hide. Accordingly, the tool might have been used as a fur burnisher or cleaner, or as a hide grainer. In reference to tanning hides, Mandelbaum (1979:60) writes

Table 11.6. Stone tools from Layer VII.

Type	Catno	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
bar abrader	1280	2	76.5	112	20	20	andesite	?	11.6
cylindric abrader	2562	4	648.2	118	60	50	limestone	n	11.7
endscraper	1260	1	4.7	24	21	6	petrified peat	y	11.8g
endscraper	1259	1	5.2	28	24	5	petrified wood	?	11.8f
endscraper	2662	5	7.3	28	27	6	petrified wood	y	11.8c
endscraper	2677	5	2.0	16	22	6	petrified peat	y	11.8d
endscraper	2547	4	4.4	26	24	6	Gronlid Siltstone	y	11.8e
hammerstone	1977	*0	627.1	108	72	66	sandstone	y	11.9
MURL	1255	1	2.4	28	24	3	petrified peat	y	11.8k
MURL	1305	1	8.4	29	27	9	silicified sediment	y	11.8m
MURL	2670	5	2.2	28	26	3	Knife River Flint	n	11.8h
MURL	2672	5	1.1	15	19	3	petrified peat	?	11.8j
MURL	2543	4	1.3	22	20	4	chert	y	11.8i
MURL	2736	6	1.4	33	15	3	agate	y	11.8l
MURL	2746	6	1.5	19	17	3	chert	?	11.8n
projectile point	2726	6	3.3	33	20	6	quartzite	y	11.8a
projectile point	2748	6	0.5	13	15	2	petrified peat	n	11.8b

* found at the edge of Test Profile No. 3.

that the Plains Cree used a stone to assure that the hide was dry. After applying a mixture of liver and brains, leaving it over night, soaking it in water and wringing it out, they briskly rubbed a smooth stone over the hide to insure thorough drying. This suggests another possible function for catno 1280, as a compression tool for removal of water from hides.

Polished bar-shaped abraders have been found occasionally in association with Shield Archaic and Taltheilei assemblages in the northern subarctic regions (Gordon 1976:231). They have also been found in Laurel associations in Manitoba and Minnesota (Buchner 1979:55; Stoltman 1973:103). Until the present occurrence they were not known in a northern Plains context.

Cylindrical abrader (n=1). Catno 2562 is an elongated, roughly cylindrical, pestle-like limestone cobble whose side was used for abrading or burnishing a flat object (see Fig. 11.7). The tool was broken when found. Two pieces were recovered in excavations south of hearth F7-c, and the third is still missing. There are three long end-to-end abrading facets on the tool. The other parts of the surface show only the natural pock-marked smoothness of pebble cortex. The larger end is quite flat and pocked with numerous shallow holes which could be mistaken for evidence of light pounding, but under close examination, the pock marks have the same weathered appearance as unmodified cortical areas on the sides. We conclude that the large end was not used for pounding. The other end, smaller and rounded, shows a slight amount of wrap-over smoothing and striation from the long side-facets. It also has a separate smooth flat facet which touches and aligns with the largest side-facet, although in a much different plane. The few striations that can be seen on the end-facet are parallel to those on the side-facets. The long side-facets are quite smooth, in places covered with striations parallel to the long axis, and, toward the large end especially, flattened due to hard or extended use.

It appears that catno 2562 had a similar function to the catno 1280 bar abrader. One difference, however, was the direction of application. The bar abrader was pushed so that the tool passed diagonally over the object surface. The cylindrical abrader was applied along its own long axis to a flatter, firmer surface. A possible function for this tool might be to smooth and whiten the surface of a piece of raw hide. We do not know of any exactly similar tool from the northern Plains, but facetted cylindrical abraders have been found in a suspected Laurel context at McKinstry Mound 2 in Minnesota (Stoltman 1973:103).

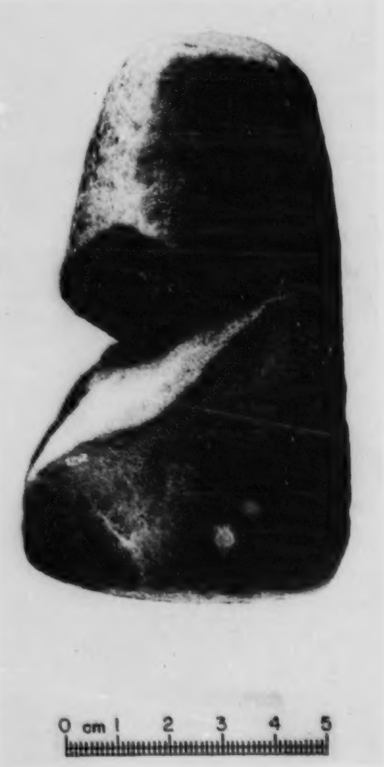


Figure 11.7. Cylindrical abrader, Layer VII.

Endscrapers (n=5). Four of five endscrapers from Layer VII (catnos 1260, 2547, 2662 and 2677) are made on thick expanding flakes (see Fig. 11.8). In each case the distal end is steeply retouched on the dorsal face, creating a convexly curved edge. The sides show varying degrees of unifacial retouch which created slightly convex edges. Two of these scrapers (catnos 2547, 2662) have serious material or chipping obstacles on one side, flaws which could not be overcome. One has moderate wear and the other light wear on the distal working edge. It appears that both were discarded when hinge fracturing along the distal edge, combined with edge flaws, precluded further sharpening. The other two scrapers have no lateral edge faults and appear to have been through several dulling and sharpening cycles. One of them (catno 2677) has been resharpened so often that its original long axis (proximal to distal end of the parent flake) has become shorter (1.5 cm) than its width (2 cm). One point of contrast among the endscrapers is the degree of wear on lateral edges. Catnos 2547, 2662 and 2677 show little or no lateral edge wear, but both lateral edges of catno 1260 are as heavily worn and almost as steeply retouched (and hinge fractured) as the distal edge. It is hard to imagine a haft which would accommodate the (rotated) use of catno 1260, and we suspect that at least this endscraper was hand-held rather than hafted.

Catno 1259 shows wear and retouch on one side and on parts of one end. The specimen

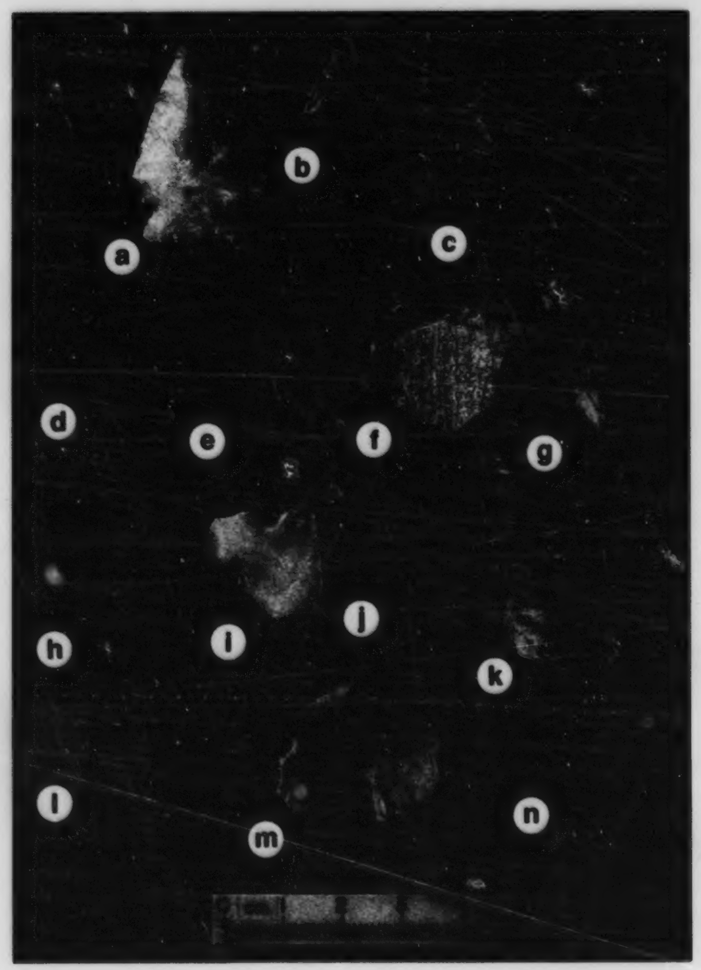


Figure 11.8. Chipped stone tools from Layer VII. a-b, projectile points; c-g, endscrapers; h-n, MURLs.

appears to have been an ad hoc tool made on a curved piece of chipping shatter (petrified wood). The "distal" end was probably first used without shaping by retouch, because the natural fracture plane was close to the required edge angle and curvature. However, it appears that an attempt to sharpen the distal edge encountered obstacles which could not be overcome, even by removing flakes from both ventral and dorsal faces of the edge. Presumably the tool was discarded at that point.

The distribution of the Layer VII endscrapers seems to show an association with hearth F7-c (Fig. 11.1). Two endscrapers were within 60 cm of the hearth's north and northeast edge, while three were to the south and southwest in XUs 4 and 5. If, as is usual today, the wind had been blowing from the southeast, then those would have been smoke and ash-free areas in which to work.

Hammerstone (n=1). Catno 1977 is a roughly cone-shaped sandstone cobble (see Fig. 11.9). Its larger end is flat and pitted. Around the edge of that end are six flake scars which run down the sides. Midway down one side there is a small freshly pitted area measuring 20 x 10 x 1.5 mm deep.

The end-pitting and flake scars may indicate that the stone was used for pounding something hard, such as stone chipping material or bone. The pitted area on the side resembles a seat on an anvil against which a sharp-edged chipped stone core could have been rested and struck. The hammerstone was found in the eroded creek bank profile less than a meter beyond the southwest corner of XU 6 and at a level equivalent to Layer VII. Similar tools have been found in other Late Prehistoric northern Plains contexts such as Besant levels of the Kenney site, Alberta (Reeves 1983a:106-107), a Prairie Side-notch component (level 24) at the Gull Lake site, Saskatchewan (Kehoe 1973:112-114), and a Besant component at the Melhagen site, Saskatchewan (Ramsay 1991:400).

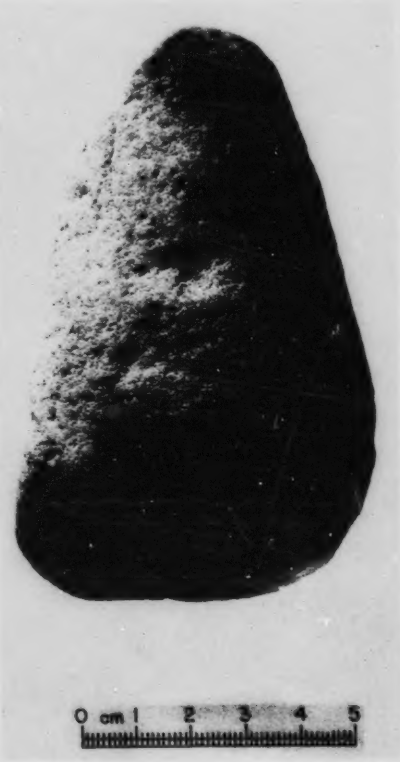


Figure 11.9. Hammerstone from Layer VII.

MURLs (n=7). Catnos 1255, 2543, 2670 and 2672 are made on expanding flakes, catno 2736 on a contracting flake, and catno 2746 on an irregular piece of shatter. The number of worn and/or retouched edges per item ranges from one to three, and the length of worn/retouched edges varies (15-32 mm). Worked edges tend to be situated in side positions, although one specimen (catno 2543) makes use of both sides and the distal end of the parent flake. Such thin sharp tools were probably used as fine cutting instruments for medium-soft materials such as sinew, hide and perhaps wood. Catno 1305 was an irregular spall on which one naturally convex edge was used, apparently as an endscraper, to the point of rounding and polishing the edge. Two chips were removed at one end of the edge's dorsal face, and one chip was removed at the other end. They represent attempts to retouch the dulled edge, but the retouch flakes came off at such a steep angle as to be ineffective, and presumably prompted discard of the object. The distribution of MURLs conforms to that of endscrapers, several being found north and southwest of hearth F7-c. There were also a couple of MURLs in the vicinity of hearth F7-b.

Projectile points (n=2). Catno 2726 is a straight-based, side-notched and nearly straight-sided projectile point made of fine grey quartzite (see Fig. 11.8). The basal edge has been thinned but not smoothed. The notches are shaped like rounded "V"s, about 5 mm at their widest and about the same in depth. The distance from one notch to the other (neck width) is 12 mm. The notches are situated so low on the sides that their manufacture has removed the basal corners. Nevertheless, if a line across the mouth of a notch were bisected, the line of bisection would intersect the side of the point, hence the attribution "side-notched". The orientation of the same line of bisection would be nearly perpendicular to the long axis of the point, but with a slight tilt as if angled slightly upward and inward from just above the corner. The sides are very gently convex and meet at a sharp tip. One edge is worn to the point of being noticeably rounded especially along a 20 mm span midway between notch and tip. The other side is much less worn and not at all rounded. The differential wear on the two sides may be an indication that one side was given extra use for cutting something. The less worn side has a damaged shoulder due to the removal of a single chip at the juncture between side and notch. This may be the reason why an otherwise handsome projectile point was used as a knife and then discarded. By size one would guess that this specimen falls between arrowhead and dart. Such intuition is confirmed by the Thomas (1978) classification equations for arrowheads and darts which yield values of $C_{dart} = 12.45$ and $C_{arrow} = 12.79$, results which are too close to allow a confident decision. Catno 2726 was associated with hearth F7-b.

Catno 2748, the tip of a pointed biface, presumably a projectile point, also was found in the vicinity of hearth F7-b. It is made of petrified peat and its edges are crudely retouched, but quite sharp. The fracture line is perpendicular to the faces and diagonal to the long axis of the item.

Comparisons show that Catno 2726 is generally similar to straight-based varieties of the Besant type (cf. Wettlaufer 1955; Gruhn 1971; Ramsay 1991). However, the symmetry of notch depth to notch width is not typical of Besant points which generally have broader shallower notches. Catno 2726 is more like Kehoe's (1965, 1974) Samantha type which he attributes to a transitional position between Avonlea and Besant. Components identified by Kehoe (1974) as Samantha have been radiocarbon dated to about 1535 BP which is within the estimated age range of Layer VII (AD 150-650).

Chipped Stone Debris

Layer VII chipping materials (Tables 11.7, 11.8) are dominated by petrified peat (54.7% by weight), quartzite (23.1%), chert (6.8%) and Gronlid Siltstone (4.0%). The high percentages of petrified peat and quartzite indicate a strong reliance on local river valley stone resources for chipping materials. The source of chert is unknown but could also be local. The only known Gronlid Siltstone sources are on the Saskatchewan River some 250 km northeast of the Sjovold Site (Johnson 1986). Swan River Chert (3.4%) and Knife River Flint (0.3%) are present only as a trace, but suggest additional commerce toward the northeast in east-central Saskatchewan (SRC) as well as to the southeast in North Dakota (KRF). Average weights of chipped debris show that reduction did not go very far in this component. Four materials — quartzite, chert, petrified peat and Gronlid Siltstone — yield pieces of large size (3.0 g or greater). Another four — quartz, petrified wood, agate and Swan River Chert — were reduced to medium-size pieces (1.0-2.9 g). Only two materials — silicified

Table 11.7. Chipped stone debris, excluding cores, from Layer VII.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
agate	2	-	-	-	1	1	4
chert	6	-	-	2	-	-	8
Gronlid Siltstone	-	-	-	6	1	-	7
Knife River Flint	2	-	1	-	-	-	3
petrified peat	28	1	13	6	9	26	83
petrified wood	-	-	2	3	2	3	10
quartzite	12	-	1	-	6	4	23
quartz	-	-	-	1	2	2	5
Swan River Chert	4	-	1	1	9	3	18
silicified sediment	8	-	4	1	-	2	15
Total	62	1	22	20	30	41	176
Weight							
agate	4.0	-	-	-	1.7	0.4	6.1
chert	35.2	-	-	2.2	-	-	37.4
Gronlid Siltstone	-	-	-	19.5	2.5	-	22.0
Knife River Flint	0.9	-	0.6	-	-	-	1.5
petrified peat	132.5	0.3	23.0	43.5	16.8	86.4	302.5
petrified wood	-	-	0.4	5.4	6.7	4.0	16.5
quartzite	37.4	-	7.7	-	28.2	54.3	127.6
quartz	-	-	-	0.5	5.9	2.6	9.0
Swan River Chert	3.4	-	0.0	5.1	9.3	1.2	19.0
silicified sediment	4.1	-	2.3	1.2	-	3.9	11.5
Total	217.5	0.3	34.0	77.4	71.1	152.8	553.1

Table 11.8. Chipped stone cores from Layer VII.

Type	Catno	XU	Weight	Size*	Material	Fig.
bipolar	1214	3	4.3	b	chert	11.10b
bipolar	2645	5	196.4	c	quartz	11.10e
bipolar	2540	4	5.4	a	Swan River Chert	11.10c
simple	2724	6	557.1	d	quartzite	11.10d
simple	2721	6	85.5	b	quartzite	11.10a

* size refers to categories based on greatest length: (a) 13-25mm, (b) 26-49 mm, (c) 50-100 mm, (d) 100-149 mm, and (e) 150 mm and larger.

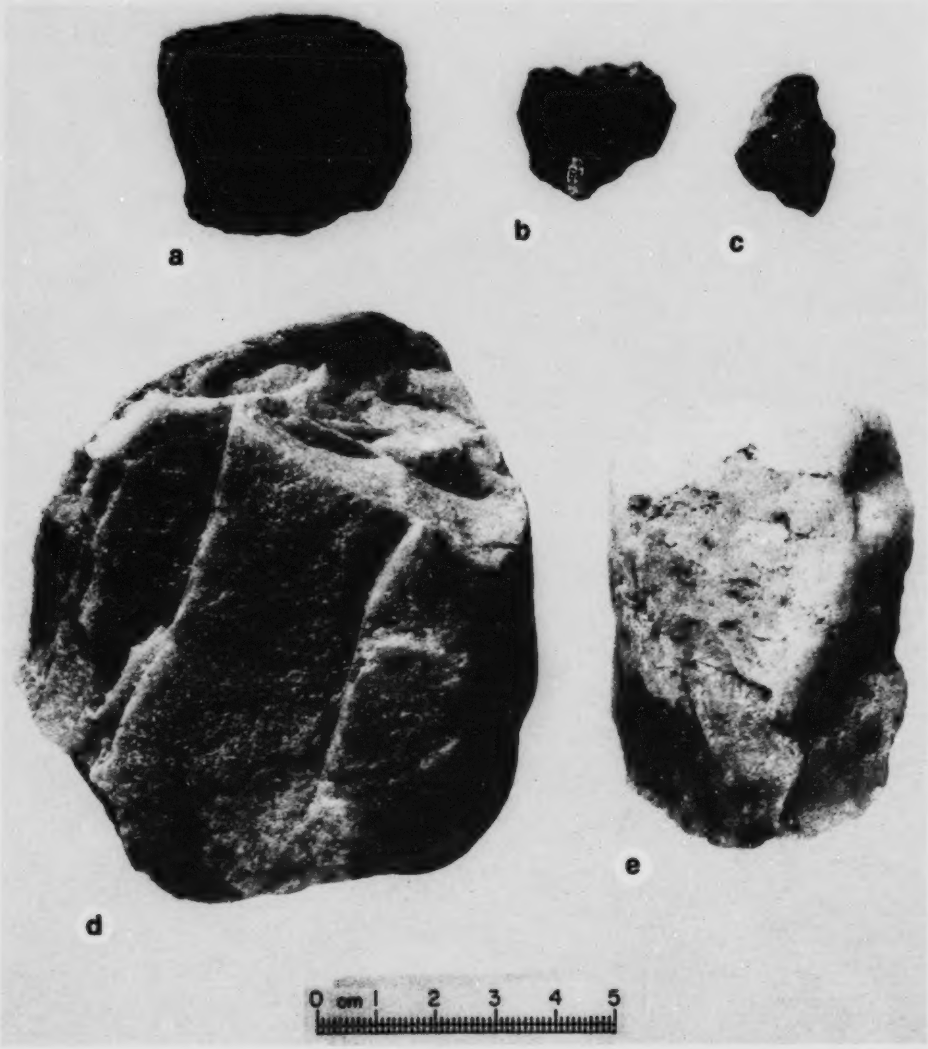


Figure 11.10. Chipped stone cores from Layer VII.

sediment and Knife River Flint - have average weights in the small size range. These facts indicate that our exposure of Layer VII was a place where stone chipping was devoted mainly to opening up raw materials and to roughing out a few pieces.

The same notion is supported by chipped stone cores (Table 11.8). Quartzite cores are of the simple variety; the others are bipolar (see Fig. 11.10). The quartzite and quartz cores are notable for their large size. Apparently they were merely opened and then abandoned. However, the Swan River Chert core is reduced to the limit as might be expected for a finer grained material. It is puzzling to note that the predominant material among the chipping debris, petrified peat, was not represented by a single core.

The distribution of both chipping debris and cores shows they were concentrated around hearths F7-c and F7-b. This distribution is similar to that of the stone tools. All tool materials are represented among the debris, but some debris materials (quartzite, quartz, and Swan River Chert) are not represented among tools. This comparison is about as expected given the sample size and the probability that some tools would have been made or only retouched at the site and then carried away.

Faunal Remains

The scarcity of bone in XUs 1-3 (Table 11.9) reflects selection for three radiocarbon samples (S-1763, S-1764, S-1765). XU 1 contributed to both S-1764 and S-1765. All unidentifiable bone from XU 2 was sacrificed for S-1764, and XU 3 contributed to S-1763.

Bison, NISP=36: mandibular angle, ascending ramus, P_4, cervical centrum, cervical neural arch, 1st thoracic arch, four thoracic neural spines, lumbar centrum, lumbar transverse spine, unassigned vertebral arch, sternal ziphoid process, 1st rib, rib fragment, distal scapula ♂, two humerus shafts, distal humerus ♂, proximal radius ♀/$^{\odot}$, distal radioulna ♂, ulnar semilunar notch, radial carpal ♂, intermediate carpal ♂, carpal 2+3 ♂, two proximal metacarpals ♂ ?, front 1st phalanx ♂, distal femur $^{\odot}$, two distal tibiae ♂ $^{\odot}$, tibia shaft, lateral malleolus ♂, hind 1st phalanx ♂?, unassigned 1st phalanx. Portions of a very young calf are represented by the distal femur, distal tibia, and the unassigned phalanx. An older calf or adult cow is represented by the proximal radius, and one or more bulls provided eleven other elements, including most of a right forelimb. A well preserved impact scar on one proximal metacarpal probably reflects marrow retrieval. Multiple transverse cut marks on the ascending ramus were probably inflicted during dismemberment. The ulna fragment has been punctured by carnivore gnawing that removed the olecranon process. Tooth marks are also seen on the 1st thoracic arch, a thoracic neural spine, and the ziphoid process. Nine bones are weathered to Stage 1 and three to Stage 2. All of the bones are etched by rootlets, six of them to a moderate degree.

Size 5-6 mammal, unidentified, n=115: 29 tooth, 16 rib, two scapula, 68 long bone shaft fragments. The large number of long bone fragments may reflect fracturing for marrow procurement. One of them bears multiple cut marks, possibly from filleting, and one of them is charred.

Deer or Pronghorn, NISP=2: two long bone shaft fragments.

Table 11.9. Vertebrate remains from Layer VII.[a]

Size, Taxon	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
6, Bison	12	7	-	5	9	3	36
5-6, mammal	18	-	9	50	18	20	115
5, Deer or Pronghorn	-	-	2	-	-	-	2
5, Deer	3	-	-	-	-	1	4
4, Dog or Coyote	-	-	4	-	-	3	7
3, Rabbit or Hare	-	-	-	*5	-	-	5
3, mammal	1	-	-	-	-	-	1
2, Ground squirrel	*1	-	-	-	-	-	1
1, Meadow vole	-	-	-	-	-	1	1
-, mammal	208	-	101	218	442	219	1,188
Total	243	7	116	278	469	247	1,360
Weight							
6, Bison	553.7	503.6	-	580.4	640.0	388.0	2,665.7
5-6, mammal	52.4	-	36.5	219.4	117.4	146.7	572.4
5, Deer or Pronghorn	-	-	3.3	-	-	-	3.3
5, Deer	0.8	-	-	-	-	5.5	6.3
4, Dog or Coyote	-	-	2.1	-	-	3.7	5.8
3, Rabbit or Hare	-	-	-	1.7	-	-	1.7
3, mammal	0.1	-	-	-	-	-	0.1
2, Ground squirrel	0.1	-	-	-	-	-	0.1
1, Meadow vole	0.1	-	-	-	-	-	0.1
-, mammal	65.1	-	44.7	157.4	237.4	124.9	629.5
Total	672.3	503.6	86.6	958.9	994.8	668.8	3,885.0

a. Superscripts (*) signify that all of these elements are thought to be intrusive into this layer.

Deer, NISP=4: I_2, two I_3, distal metapodial fragment.

Dog or Coyote, NISP=7: I^2, I^3, C^1, P^2, P^3, two tooth root fragments. These fully adult, well worn teeth are much too small to represent a wolf, but lacking evidence concerning their alveolar spacing there is no means of distinguishing between dog and coyote.

Rabbit or Hare, NISP=5: thoracic, two lumbar vertebrae, metacarpal III, distal femur. Differential staining and lack of rootlet etching suggest that these bones are intrusive into Layer VII.

Size 3 mammal, unidentified, n=1: long bone shaft.

Ground Squirrel, NISP=1: atlas vertebra. Like the leporid bones, this specimen is believed to be intrusive into Layer VII, because it is very lightly stained and lacks rootlet etching.

Table 11.10. Modified vertebrate remains from Layer VII.[a]

Size, Taxon	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Fracture States Recent	Dry	Fresh	Whole	Total
6, Bison	1	-	4	-	12	36	1	3	11	15	6	36
5-6, mammal	1	1	-	-	*	*	29	6	21	59	-	115
5, Deer or Pronghorn	-	-	-	-	-	-	-	-	1	1	-	2
5, Deer	-	-	-	-	-	4	3	-	1	-	-	4
4, Dog or Coyote	-	-	-	-	-	7	7	-	-	-	-	7
3, Rabbit or Hare	-	-	-	-	-	-	-	-	-	1	4	5
3, mammal	-	-	-	1	-	1	-	-	-	1	-	1
2, Ground squirrel	-	-	-	-	-	-	-	-	-	-	1	1
1, Meadow vole	-	-	-	1	-	-	-	-	-	1	-	1
-, mammal	1	374	-	5	*	*	-	*	*	*	-	1,188

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

Meadow vole, NISP=1: mandible containing I_1-M_2. Evidence of digestion is comparable to that seen in owl pellets.

Unidentified mammal, n=1188: fragments of which 1176 are less than 4 cm long and 12 are 4-8 cm long. One bears a single cut mark, and five have been digested. There are 262 charred and 112 calcined fragments, most of them from XU 5 where they were probably associated with Feature F7-c located just to the northeast.

Freshwater Clams: Of 13 pelecypod fragments, 11 were found in XU 6, and the others occurred in XU 1. The concentration of fragments in XU 6 suggests that freshwater clams were among the consumables associated with F7-b.

Plant remains: We collected one charcoal sample (22 pieces, 2.2 g) from F7-b in XU 6.

Discussion: Portions of three bison age/gender groups are represented in Layer VII with adult bull(s) accounting for most of the measurable elements. At least a third (by weight) of the large mammal bone from XUs 1-3 was sacrificed for a radiocarbon date. Lacking evidence to the contrary, it is reasonable to suggest that the deer was acquired during subsistence pursuits. The canid teeth must have been deposited near the boundary of XUs 3 and 6, because their size and state of wear show that all of them could represent a single individual. It is not uncommon for large canids to be represented only by cranial elements in northern Plains sites. Elsewhere (Morlan 1994c) it has been suggested that such finds may reflect the use of camouflage robes for stalking bison.

The relatively heavy weathering seen on the bison bones indicates a somewhat prolonged period of time on the surface, and during that time an owl may have regurgitated a pellet containing the meadow vole mandible. The leporid and ground squirrel bones may have occurred in the lowermost reaches of the loosely infilled (badger?) burrow encountered primarily in Layers IV-VI.

Interpretation of Layer VII

Our exposure of Layer VII revealed two foci of activity at the edge of the creek bank. One surrounded a buffalo chip fire. North and northeast of that hearth were a couple of endscrapers and MURL cutting edges indicative of hide thinning and/or cleaning and cutting. On the south edge was evidence of stone heating and of bone or bone and meat roasting. Further south and west was an activity area or disposal area which contained blackened and ashy soil, fire-broken rocks, scattered bone fragments, more endscrapers and MURLs along with two kinds of abraders which could have been part of the hide working tool kit. In the general vicinity of the hearth were several sherds and crumbs of knotted cord impressed pottery and a sparse scatter of chipped stone debris. Thus, the activities which occurred around the first hearth seem to have included (1) scraping of pliable hides; (2) burnishing, graining or drying of pliable hides; (3) smoothing or possibly whitening of raw hides; (4) heating of rocks for purposes unknown; (5) roasting of bison bones and/or meat, presumably for consumption at the fireside; (6) a modest amount of stone tool manufacture or sharpening; and (7) the breakage or disposal of a small part of a clay pot. This assortment of activities suggests the presence of one or more women since hide dressing was traditionally a woman's task in Plains Indian societies. The use of buffalo chips as fuel suggests an outdoor location since such fuel burns best with a breeze and creates large quantities of smoke when confined. The number of tools and their degree of wear seem roughly appropriate to the preparation of the hides of at least three bison and one deer, as estimated for this exposure by bone identifications.

The second focus of activity, situated about 3.5 m west of the first, encompassed a small wood fire and a shallow oval rock-filled pit. On top of the fire were a few fired rock fragments. In it were a few pieces of the same type of pottery, possibly the same vessel, as was found near the other hearth. Beside the hearth was a fine quartzite dart or arrow head. Around the hearth to a distance of about 2 m was a scatter of fairly large bone fragments, various sizes of coarse rock fragments, a fair amount of chipping debris mainly of large and medium size, and a few stone tools including a couple of MURL cutting edges, a projectile point tip and a hammerstone. All of this lay on and in a buff-brown soil matrix. The activities which occurred in this area included (1) cutting of a soft substance such as hide or sinew (dart/arrowhead and MURLs); (2) roasting of rocks, possibly for use in the nearby rock-filled pit; (3) consumption of bison bones and meat; (4) use(?) and disposal of part of a clay pot; (5) opening and reduction of several pieces of chipping stone; and (6) the enigmatic use of the rock-filled pit, possibly for shield-making, or for food roasting. This group of activities is suggestive of male presence, especially if the rock pit was used for shield-making. Whether the activity occurred indoors or out is not clear. The hearth was situated only a little more than one meter from the present creek bank. Allowing another meter or so for land lost to erosion during the past 1600 years would still put the hearth very close to the bank, too close for the center of a tipi. Furthermore, the rock pit would have radiated a tremendous amount of heat which also makes the enclosure idea seem unlikely. Consequently, our guess is that this activity area was also out-of-doors.

The season of occupation is unknown, but the suspected outdoor situation suggests warm or at worst cool weather, rather than cold. The intensity of occupation was not great, appropriate probably to a family or an extended hunting group. The duration, estimated from the number of tasks undertaken, the moderate disaggregation of fire rocks, the time to preserve and/or consume parts of three or more bison and a deer, was probably more than a couple of days and less than a couple of weeks. The absolute age of the component falls between AD 150 and AD 650 (cal 1800-1300 BP; Table 3.6).

The archaeological identity of Layer VII occupants is not clear given the Samantha projectile point, the Besant-like hammerstone, and the Avonlea ceramic type. For the time being, we attach the label Samantha/Avonlea. The resources used by these Samantha/Avonlea occupants indicate that they were primarily dependent on local coarse rock, local chipping stone and probably local game. The trace of Knife River Flint indicates either recycling of other peoples' exotic discards or commerce toward the KRF quarries in North Dakota. The trace of Gronlid River Siltstone indicates either recycling or commerce in the opposite direction, to the northeast. In any case, it appears that Layer VII occupants were probably near the center of their home territory.

Interlayer VII/VIII

This interlayer was excavated as a separate unit only in XUs 1-3. In XUs 4-6 the materials of Layer VII and those of Interlayer VII/VIII were excavated as one unit all of which is included in the foregoing descriptions of Layer VII.

Coarse Rock: Fourteen pieces of coarse rock weighing 46 g were recovered in XUs 2 and 3. Included are andesite (two pieces), gneiss (2), granite (3), mudstone (1), quartzite (1), sandstone (1) and unidentified (4). In addition, one small friable piece of red hematite (ochre) was found in Interlayer VII/VIII. Recovered from XU 2, it measures 7x6x6 mm and weighs 0.2 g. Such material was often used as an ingredient in paints.

Pottery: Two body sherds of vessel D (catno 1237) weighing 3.1 g were found in XU 3. These are presumed to be intrusive from Layer VI.

Chipped Stone Debris: Some 43 pieces of chipping debris (including one core) weigh a total of 25.5 g. Materials include chert (two pieces), petrified peat (21), petrified wood (4), quartzite (10), quartz (1), silicified sediment (4) and unidentified (1). Considering the small average size (less than 1 g) of these pieces, it seems likely that most have been trampled down from Layer VII. The dominance of petrified peat and quartzite, as in Layer VII, gives support to this proposition.

Faunal Remains

Bison, NISP=2 (18.3 g): ulna shaft (XU 1), lateral malleolus ♀/© (XU 3). The ulna fragment was fractured when fresh, and both bones have been etched by rootlets.

Size 5-6 mammal, unidentified, n=22 (63.4 g): seven tooth, one vertebra, four rib, 10 long bone shaft fragments, rather evenly distributed across the excavation units. Twelve were fractured when fresh.

Rabbit or Hare, NISP=1 (0.2 g): tibia shaft (XU 1). It was fractured when fresh and has been superficially etched by rootlets.

White-tailed Jackrabbit, NISP=1 (0.2 g): proximal radius (XU 1). This bone was fractured when fresh and exhibits both rootlet etching and pitting and thinning by digestion.

Size 3 mammal, unidentified, n=5 (0.6 g): five long bone shaft fragments (XU 1). They have been pitted and thinned by digestion and are superficially rootlet-etched.

Unidentified mammal, n=234 (138.5 g): fragments less than 4 cm in length. Four fragments, two each in XUs 1 and 3, have been digested. Eight charred fragments were found in XU 2, and one calcined piece occurred in XU 3.

Minnow, NISP=1 (0.1 g): pharyngeal (XU 2). This bone represents either Lake Chub (*Couesius plumbeus*), Flathead Chub (*Hybopsis gracilis*), or Pearl Dace (*Semotilus margarita*). It has been superficially etched by rootlets.

Snails: One small gastropod was recovered from XU 1.

Discussion: There is no basis for linking these remains with either Layer VII or Layer VIII. The leporid, medium-size mammal, and fish bones may have been deposited in an avian predator's pellet or a mammalian predator's scat, because most of them are pitted and thinned by digestion. The presence of rootlet etching on these bones suggests that they are contemporaneous with the other interlayer faunal remains and were not derived from the loosely infilled (badger?) burrow where leporid remains occurred in overlying layers.

Chapter 12

Layer VIII: An Enigmatic Occupation

Introduction and Planview

Layer VIII lies 124-130 cm BS at 2n2w, on and under a very faintly developed soil horizon labelled Ahb6. In XUs 2 and 5 the Ahb6 horizon faded into the surrounding buff-coloured matrix. Determining the vertical position of the layer in such areas was extremely difficult and relied mainly on extrapolation from adjoining units. Layer VIII seemed to have a high point at about 2n1w from which the east-to-west slope was downward at about 17:500 and north-to-south slope was downward at about 5:400. The slope was greater at the west side of excavations. Only one feature, a concentration of fired rock, appeared in this layer. A sparse scattering of occupation debris did not include diagnostic tools, so the cultural identity remains unknown. A radiocarbon date on bone indicates that occupation took place between 150 BC and AD 350 (cal 2100-1600 BP; Table 3.6). Interlayer VIII/IX consists of a buff-coloured layer of sands and silts extending from about 130 cm BS to about 135 cm BS at 2n2w. We excavated Layer VIII and Interlayer VIII/IX separately in XUs 1-3, but combined them in XUs 4-6. In fact, all materials from Layers VIII, VIII/IX, IX, IX/X, and the top of X were combined in XUs 4-6, because it was impractical to remove them separately. In this chapter there are separate sections for materials from Layer VIII (XUs 1-3), Interlayer VIII/IX (XUs 1-3), and the combined VIII+IX unit from XUs 4-6.

The planview (Fig. 12.1) shows the locations of one feature and all of the stone tools and identified bison bones ascribed to Layer VIII. The stone tools include one end scraper and two MURLs. Among the bison bones are two ribs, two metacarpals, three front phalanges, and a talus. Several long bone, tooth, and vertebra fragments represent unidentified size 5-6 mammals, probably bison.

Features

Feature F8-a (Figs. 2.7, 12.1; Table 12.1), the only feature exposed in Layer VIII, was discovered during the trowelling of Test Profile #2 along the creek bank. Part of one rock was showing as we began trowelling at a spot which eventually turned out to be Layer VIII in the southeast corner of XU 4. We believe that little or nothing had been lost from the feature before our arrival, but there is no way to be certain. Our later exposure of the rest of XU 4 (by shovel skimming of layers VIII and IX combined) revealed the small remaining part of F8-a, and some scattered debris to the north and west, but no other features. F8-a comprised a cluster of at least 23 rocks within a roughly circular area about 55 cm north-south by 80 cm east-west. Most of the rocks appeared to be

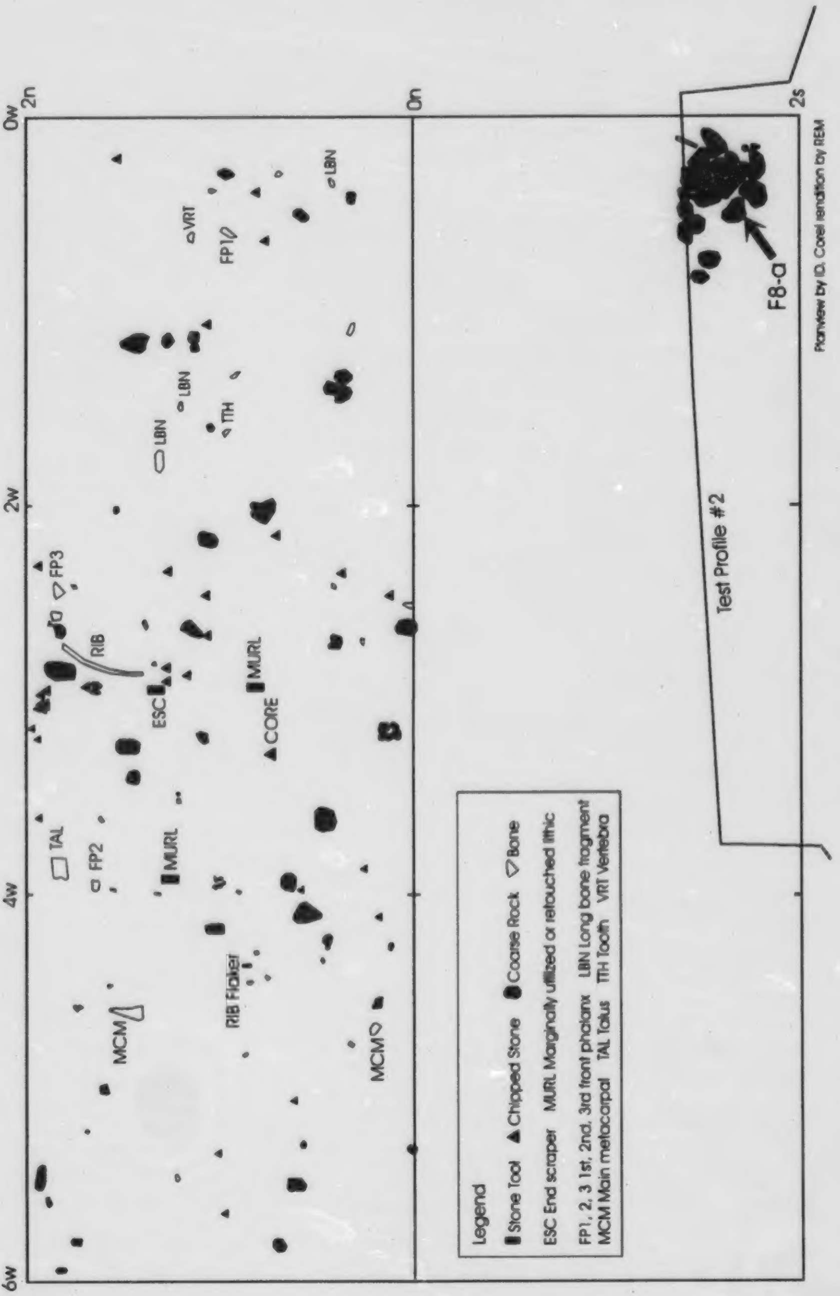

0w
2n
2w
4w
6w
0n
2s
TAL
FP2
FP3
RIB
ESC
MURL
MURL
CORE
LBN
LBN
LBN
LBN
VRT
FP1
TH
MCM
MCM
RIB Flaker
F8-a
Test Profile #2
Planview by ID. Corel rendition by REM
Legend
Stone Tool ▲ Chipped Stone ● Coarse Rock ▽ Bone
ESC End scraper MURL Marginally utilized or retouched lithic
FP1, 2, 3 1st, 2nd, 3rd front phalanx LBN Long bone fragment
MCM Main metacarpal TAL Talus TTH Tooth VRT Vertebra

Figure 12.1. Planview of Sjovold Layer VIII.

Table 12.1. Feature in Layer VIII.

Type	FeaNo	CenterPt[a]	Length[b]	Width	Thickness
rock cluster	F8-a	155s35w	55	80	14

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

resting at one level, apparently the surface of the layer. However, two or three were beneath the north-central part of the group, and two others, at the west side, were about half submerged beneath the other rocks. The whole cluster may have covered a shallow pit or hollow. Twelve rocks are 10 cm or more in greatest dimension and have a combined weight of about 10 kg. The rest are smaller and have a combined weight of just under 5 kg. Most of the rock is granite or gneiss, but two slabs of mica schist are also included. Except for one piece of mica schist all the rock was severely "weathered" with both cortical and fractured surfaces that were rough, granular and near the point of disaggregation. Several large rocks had broken *in situ*. Lighter coloured ones have a pinkish or yellowish hue. The combined characteristics are indicative of prolonged or, more likely (in view of the generally large size of the rocks), intense exposure to fire. The enclosing soil was very similar to the buff/grey-brown colour of the intermittent Ahb6 soil horizon associated with Layer VIII. On the west edge of F8-a the soil was slightly blackened and had slightly greater calcium carbonate speckling than elsewhere in the layer. A bone cylinder, possibly a shaft fragment from the bone of a young or medium-size mammal, was found within 5 cm of the northeast edge; a few smaller fragments of bone and a piece of petrified peat chipping debris were located at the southwest edge. We found three fish scales near the feature, but they may or may not be functionally associated.

The rocks of F8-a were apparently used for some form of heating such as steaming, boiling or roasting. Their extreme state of weathering indicates that they had been subjected to intense firing. Yet, the small amounts of blackened or ash-infused earth in the vicinity were insufficient to account for firing of the rocks within the feature. Rather, it would appear that firing took place beyond our exposure. Nonetheless, we should consider whether F8-a was the place where the fired rocks were used and abandoned, or whether it was just a disposal site. Because of the tight clustering we are inclined to suspect the former, in which case possible interpretations include stone boiling "pit," roasting "pit" or sweat lodge steaming "pit." Unfortunately, our observations about this feature's context are incomplete due to prior creek bank erosion and our own two-phase exposure of the remains. Consequently, we do not have sufficient basis for choosing among alternate interpretations.

Rock

Coarse rock from XUs 1-3 of Layer VIII includes 51 specimens weighing 7.1 kg (Table 12.2). The rock from feature F8-a is included in the section on mixed VIII-X materials from XUs 4-6.

Table 12.2. Coarse rock from Layer VIII.

	Number				Weight			
Material	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
amphibolite	-	-	1	1	-	-	12	12
andesite	1	-	-	1	9	-	-	9
basalt	-	-	3	3	-	-	1,160	1,160
chert	-	-	1	1	-	-	18	18
gneiss	6	5	3	14	876	1,902	392	3,170
granite	3	15	1	19	981	847	11	1,839
grano-gneiss	1	-	-	1	304	-	-	304
limestone	-	1	2	3	-	30	33	63
quartzite	-	1	1	2	-	65	16	81
schist	-	2	-	2	-	345	-	345
sandstone	3	1	-	4	77	6	-	83
Total	14	25	12	51	2,247	3,195	1,642	7,084

The predominant coarse rock materials are gneiss (45% by weight), granite (26%), basalt (16%) and schist (5%). Almost all of the gneiss and granite shows signs of have been fired. Basalt is ambiguous with respect to firing with at least one piece showing signs of having been coarsely chipped. The average size is 138.9 g per specimen, close to the site average (159.8) and much greater than the average for the two previous layers, Layer VI (25.1 g) and Layer VII (55.7 g).

Stone Tools

Endscraper (n=1). Catno 1402 (Table 12.3) is made on the distal end and one side of an expanding flake (see Fig. 12.2). Its two unifacially retouched edges are continuous, joining at a rounded corner. The distal edge is thinner than the lateral edge. This turned out to be a significant disadvantage since a couple of sharpening flakes on the distal edge left it damaged with large nicks. Retouching on the adjoining side, however, produced a long (28 mm), smooth, gently convex scraping edge with rounded corners closely resembling the familiar shape of an endscraper edge. That lateral edge bears light rounding and polish perpendicular to its long axis and appears to have been used briefly for scraping after having been retouched. The lateral edge is still quite sharp and free of hinge fractures. If damage was the reason for discarding the object, it must have been the distal edge that was damaged, because the lateral edge looks and feels functional.

MURLs (n=2). Catno 1399 is the proximal end of a blade-like flake, possibly a bifacial thinning flake. It has fine unifacial retouching and use wear along its thickest edge, and irregular nicking and use wear along a thin opposing edge. The mid-section of the tool, catno 1344, was discovered in Interlayer VIII/IX, XU 3. The distal end, apparently less than 10 mm long, was not re-

Table 12.3. Stone tools from Layer VIII.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
endscraper	1402	2	4.2	19	29	5	Swan River Chert	?	12.2b
MURL	1399	2	2.4	27	18	4	Swan River Chert	n	12.2a
MURL	1401	2	12.3	33	34	8	chert	n	12.2c

Table 12.4. Chipped stone debris, excluding cores, from Layer VIII.

	Number				Weight			
Material	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
chert	3	1	-	4	0.2	0.6	-	0.8
Gronlid Siltstone	5	-	-	5	1.7	-	-	1.7
jasper	1	-	-	1	<0.1	-	-	<0.1
Knife River Flint	1	-	-	1	0.2	-	-	0.2
petrified peat	16	13	3	32	46.7	20.9	2.7	70.3
quartzite	-	6	1	7	-	20.3	0.6	20.9
Swan River Chert	2	1	-	3	16.0	1.6	-	17.6
silicified sediment	3	1	1	5	2.2	0.3	0.5	3.0
Total	31	22	5	58	67.0	43.7	3.8	114.5

covered. By the thinness of the edges and the signs of edge wear/polish it would seem that the probable use was for fine cutting. The fracture between pieces is vertical and nearly perpendicular to the edges, probably due to snapping. Catno 1401 is a shattered cortical spall of highly faulted yellow-mauve chert. A few flakes were removed (bifacially) along at least parts of two opposing edges. The distal end of the object was not recovered, so it is not possible to tell what portion of each edge was retouched. We suspect that the object broke in the very early stages of manufacture.

Chipped Stone Debris

Layer VIII chipping materials are dominated (Table 12.4) by petrified peat (61.4% by weight), quartzite (18.3%) and Swan River Chert (15.4%). The uses of petrified peat and quartzite indicate reliance on local river valley resources, while the Swan River Chert may be an indication of commerce to the northeast. Exotic materials such as Gronlid Siltstone and Knife River Flint are present in very small quantities. Their presence could as likely be due to recycling of locally discovered but previously lost imports as to contemporary commerce with the exotic source areas. As to the degree of reduction, average weights indicate that Swan River Chert was rendered into pieces of large size (3 g per specimen and greater), while petrified peat and quartzite were reduced to pieces of medium size (1.0-2.99 g). These size ranges, together with the overall predominance of these materials, suggest that raw

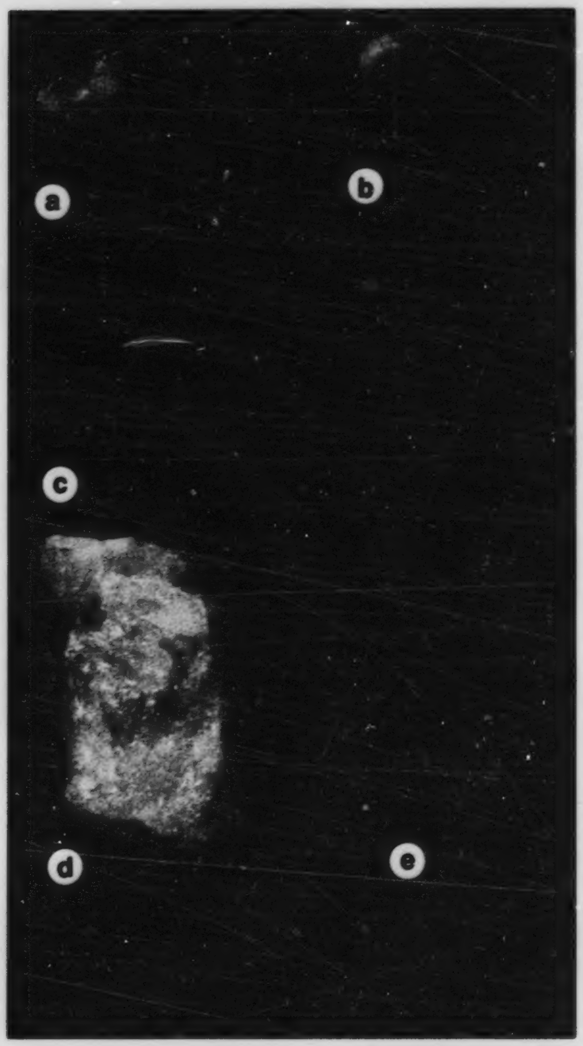


Figure 12.2. Tools from Layer VIII. a, c, MURLs; b, endscraper; d, core; e, bone flaker.

materials were being subjected to fairly early stages of reduction. All other materials are of small size and probably represent retouching or repair of existing tools. The single core from Layer VIII (catno 1381; see Fig. 12.2d) is bipolar, quartz, weighs 56.6 g, and was found in the southwest quadrant of XU 2.

Bone Tools

A bison rib fragment from XU 3 (catno 1298; see Fig. 12.2e) has been used as a pressure flaker that was discarded after its working tip collapsed. It measures 89 mm in length, and the working tip appears to have been rounded in outline and flat in section.

Faunal Remains

Some of the vertebrate remains from XU 2 in Layer VIII were included in a radiocarbon sample (S-1765), and the remainder are shown in Table 12.5.

Bison, NISP=8: two ribs, two distal metacarpals $^{\infty}$, front 1st phalanx ♂, front 2nd phalanx, front 3rd phalanx, talus ♂. The metacarpals represent a very young calf, and parts of a bull front foot and ankle are also present. A rib fragment has been used as a pressure flaker. Carnivore tooth marks are seen on one rib and the talus. Only three bones are weathered, one to Stage 2, and two specimens are moderately etched.

Table 12.5. Vertebrate remains from Layer VIII[a].

	Number				Weight			
Size, Taxon	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
Number								
6, Bison	1	4	3	8	59.1	295.3	59.8	414.2
5-6, mammal	5	14	-	19	68.9	4.2	-	73.1
5, Pronghorn	-	-	1	1	-	-	2.3	2.3
-, mammal	2	2	1	5	2.9	1.6	0.9	5.4
Total	8	20	5	33	130.9	301.1	63.0	495.0

a. Additional specimens (three fish scales, one pronghorn bone) were recovered from Test Profile #2.

Table 12.6. Modified vertebrate remains from Layer VIII.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	1	-	2	-	3	7	-	-	-	3	5	8
5-6, mammal	-	-	-	-	*	*	15	-	-	4	-	19
5, Pronghorn	-	-	-	-	1	1	-	-	-	-	2	2
-, mammal	-	2	-	-	*	*	-	*	*	*	-	5
Fish	-	-	-	-	-	-	-	-	-	-	3	3

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

Size 5-6 mammal, unidentified, n=19: 15 tooth, one vertebra, three long bone shaft fragments.

Pronghorn, NISP=2: distal metatarsal epiphysis, 1st phalanx. The phalanx was found during the initial discovery of F8-a; it is weathered to Stage 1 and moderately root-etched.

Unidentified mammal, n=5: fragments less than 4 cm in length. Two pieces from XU 2 are charred.

Fish, unidentified, n=3: three scales. Found at 120 cm B.S. in Test Profile #2, only one can be identified even to family — a sunfish (Family Centrarchidae).

Freshwater Clam: One pelecypod fragment was recovered from XU 3.

Discussion. At least two bison, a calf and a bull, and one young pronghorn are represented among these remains. The bones were slightly ravaged by carnivores either during or after the human occupation. The fish scales could have reached the site either as sedimentary particles or as the food remains of a predator.

Interpretation of Layer VIII

Our exposure of Layer VIII was not well placed. A single feature, F8-a, shows that medium-size fired rocks were used here or in the vicinity, and it is not clear whether the feature was an operational or a disposal site. The presence of the fired rock shows that there must also have been a hearth nearby. There was a sparse scatter of coarse rocks, broken bones, chipped stone debris and three stone tools in the area north and west of F8-a. The tools indicate the practice of (hide) scraping and cutting activities and suggest the presence of women since, among Plains hunting groups, women were the most likely users of such tools. The recovery of a pressure flaker shows that tool manufacture and/or maintenance was also undertaken. Subsistence depended primarily on bison, possibly supplemented by pronghorn. The cultural identity of the occupants remains unknown, because diagnostic tools were not discovered. As with many of the other site occupants, these people relied mainly on local petrified peat and quartzite for chipping materials. A fairly strong showing of Swan River Chert among both debitage and tools may be an indication that the occupants had affiliations to the northeast where Swan River Chert is more abundant. The age of occupation is in the range of 150 BC to AD 350 (cal 2100-1600 BP; Table 3.6).

Interlayer VIII/IX

This interlayer was excavated as a separate unit only in XUs 1-3.

Table 12.7. Coarse rock from Interlayer VIII/IX.

	Number				Weight			
Material	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
andesite	-	-	1	1	-	-	1	1
chert	1	-	-	1	5	-	-	5
gneiss	2	-	-	2	113	-	-	113
granite	17	13	-	30	673	15	-	688
limestone	3	-	-	3	17	-	-	17
quartzite	-	-	1	1	-	-	*	0
sandstone	1	1	-	2	36	33	-	69
slate	-	-	-	1	6	-	-	6
unidentified	1	2	-	3	10	1	-	11
Total	26	16	2	44	860	49	1	910

Rock (Table 12.7): Coarse rock from Interlayer VIII/IX includes 44 specimens weighing 0.9 kg. Granite and gneiss predominate, as in Layer VIII, though in the opposite order. With an average weight of 20.6 g, the interlayer rock is considerably smaller than that of Layer VIII, and small size may have promoted downward displacement due to trampling and other processes such as animal burrowing.

Stone Tools: One MURL (catno 1344) was found in XU 3 of Interlayer VIII/IX. It is part of a thin uniface which conjoins catno 1399 found in Layer VIII (see previous section for a description of the whole item). Catno 1344, made of Swan River Chert, weighs 1.3 g and measures 15x16x4 mm.

Table 12.8. Chipped stone debris, excluding cores, from Interlayer VIII/IX.

	Number				Weight			
Material	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
agate	-	-	1	1	-	-	0.1	0.1
chert	2	1	2	5	0.9	0.2	0.0	1.1
Gronlid Siltstone	4	-	1	5	2.0	-	1.6	3.6
jasper	1	1	-	2	0.2	1.0	-	1.2
Knife River Flint	3	-	2	5	0.3	-	1.7	2.0
petrified peat	55	41	21	117	58.3	16.7	22.6	97.6
petrified wood	11	6	-	17	14.4	8.8	-	23.2
quartz porphyry	-	-	1	1	-	-	2.2	2.2
quartzite	1	2	5	8	0.9	24.3	3.3	28.5
quartz	2	1	5	8	4.5	1.0	2.1	7.6
Swan River Chert	12	3	6	21	6.4	1.1	1.4	8.9
silicified sediment	7	5	-	12	3.3	2.9	-	6.2
Total	98	60	44	202	91.2	56.0	35.0	182.2

Chipped Stone Debris (Table 12.8): Some 203 pieces of chipping debris, including one core, weigh a total of 210.4 g. Catno 1641, a small amorphous core of Swan River Chert weighing 28.2 g, was found in XU 1. The balance of debitage was dominated by petrified peat (53.6% by weight), quartzite (15.7%), petrified wood (12.7%), Swan River Chert (4.9%) and quartz (4.2%). These proportions are roughly similar to those of chipped stone in Layer VIII from which most interlayer material is presumed to have been derived. With the exceptions of quartzite and petrified wood, which were large and medium in size, the average size of all remaining types is small (less than 1 g). That may be the reason why more pieces of chipping debris were found below the layer than within it.

Faunal Remains

Bison, NISP=4 (37.8 g): lumbar neural spine, lumbar neural arch, lumbar transverse spine, ulna shaft ©. All of these elements were found in XU 1, and all were fractured when fresh. The ulna shaft is from a very young calf. Three elements are weathered to Stage 1, and one is superficially etched by rootlets.

Size 5-6 mammal, unidentified, n=15 (43.1 g): six tooth, two rib, seven long bone shaft fragments. Seven each were found in XU 1 and XU 3, and the other occurred in XU 2. Eight were fractured when fresh.

Deer or Pronghorn, NISP=1 (0.9 g): phalanx. This bone was fractured when fresh, digested by a carnivore, and etched by rootlets.

Wolf, Dog or Coyote, NISP=1 (0.3 g): phalanx. This bone was fractured when fresh and etched by rootlets.

Unidentified mammal, n=173 (109.2 g): fragments less than 6 cm in length. These, including four charred and one calcined piece, were scattered across XUs 1-3. Two fragments from XU 3 have been digested.

Snails: One small gastropod was recovered from XU 2.

Freshwater Clams: A pelecypod fragment was found in XU 3.

Discussion. The emphasis on lumbar vertebral portions fits well with the bison bones from mixed layers VIII+IX (see below). The deer or pronghorn phalanx could belong with the pronghorn metatarsal epiphysis, also from XU 3, in Layer VIII.

Mixed Layers VIII+IX

The materials of layers VIII, VIII/IX, IX, IX/X, and the top of X were excavated as a unit in XUs 4-6. The combined materials are described in this section.

Rock (Table 12.9): The large amounts of granite and mica schist in XU 4 are attributable to feature F8-a in Layer VIII. The term granite, in this case, may be considered inclusive of grano-gneiss and gneiss.

Stone Tools (Table 12.10)

Endscraper (n=1). Catno 2785 is an expanding flake of variegated grey, white and brown chert (Cathead Chert?) with unifacial retouching and edge wear along the distal half of one side and across the whole end. The second side bears a remnant of rough pebble cortex which was not suitable for retouching. The distal edge has two large nicks due to the removal of sharpening flakes which did not carry well. The balance of the distal edge is worn smooth, presumably the reason for the failed sharpening attempt.

MURL (n=1). Catno 3186 is a flat pebble of petrified peat which has been split open by the

Table 12.9. Coarse rock from mixed layers VIII+IX.

Material	Number XU 4	XU 5	XU 6	Total	Weight XU 4	XU 5	XU 6	Total
amphibolite	-	8	1	9	-	99	115	214
andesite	2	6	-	8	5	20	-	25
basalt	4	-	13	17	5	-	43	48
chert	-	1	-	1	-	6	-	6
dolomite	-	1	-	1	-	13	-	13
gneiss	11	8	-	19	2,612	280	-	2,892
granite	28	29	26	83	11,142	515	399	12,056
grano-gneiss	109	-	-	109	206	-	-	206
limestone	11	16	26	53	16	22	157	195
mica schist	2	1	-	3	1,816	*	-	1,816
mudstone	-	2	1	3	-	1	3	4
quartzite	3	2	4	9	39	4	952	995
sandstone	13	6	1	20	255	31	61	347
unidentified	4	18	36	58	5	16	74	95
Total	187	98	108	393	16,101	1,007	1,804	18,912

Table 12.10. Stone tools in mixed layers VIII+IX.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole
endscraper	2785	4	5.3	31	21	8	chert	y
MURL	3186	6	9.3	36	36	6	petrified peat	y

Table 12.11. Chipped stone debris, excluding cores, in mixed layers VIII+IX.

Material	Number XU 4	XU 5	XU 6	Total	Weight XU 4	XU 5	XU 6	Total
agate	-	3	1	4	-	2.0	0.2	2.2
chert	11	21	18	50	10.6	77.9	64.4	152.9
Gronlid Siltstone	2	-	6	8	1.6	-	41.7	43.3
Knife River Flint	-	-	2	2	-	-	1.1	1.1
petrified peat	56	124	198	378	75.7	260.8	298.6	635.1
petrified wood	13	13	6	32	21.0	13.3	7.3	41.6
quartzite	1	15	56	72	0.9	233.7	193.9	428.5
quartz	1	10	10	21	203.3	34.5	49.1	286.9
Swan River Chert	9	6	67	82	15.2	4.4	74.2	93.8
silicified sediment	1	3	27	31	0.1	2.7	62.3	65.1
Total	108	346	464	737	346.4	634.3	798.8	1,750.5

Table 12.12. Vertebrate remains from mixed layers VIII+IX.[a]

	Number				Weight			
Size, Taxon	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
6, Bison	7	13	7	27	245.9	367.2	294.4	907.5
6, Grizzly Bear	-	-	1	1	-	-	18.0	18.0
5-6, mammal	25	30	10	65	124.3	185.7	122.7	432.7
4-5, Wolf, Dog or Coyote	-	1	-	1	-	1.2	-	1.2
3, Rabbit or Hare	*1	-	-	1	0.2	-	-	0.2
3, mammal	-	2	1	3	-	0.6	0.2	0.8
2, Ground Squirrel	*3	-	-	3	0.5	-	-	0.5
-, mammal	258	384	158	800	213.1	308.6	111.4	633.1
Total	294	430	177	901	584.0	863.3	546.7	1,994.0

a. Superscripts (*) signify that these elements are thought to be intrusive into this layer.

Table 12.13. Modified vertebrate remains from mixed layers VIII+IX.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	-	-	4	-	8	13	5	-	7	12	3	27
6, Grizzly Bear	-	-	-	-	1	1	-	-	1	-	-	1
5-6, mammal	-	-	1	-	*	*	25	2	10	28	-	65
4-5, large canid	-	-	-	-	1	1	-	-	1	-	-	1
3, Rabbit or Hare	-	-	-	1	-	-	-	-	-	1	-	1
3, mammal	-	-	-	1	-	2	-	-	-	3	-	3
2, Ground squirrel	-	-	-	-	-	-	-	-	1	2	-	3
-, mammal	-	53	-	5	*	*	-	*	*	*	-	800

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

bipolar technique. One of its sides is crudely retouched bifacially. The slightly sinuous edge shows signs of light crushing and wear/polishing as if used for cleaving a tough substance.

Chipped Stone Debris (Table 12.11): There are two cores from the mixed VIII-X unit. Catno 2782, a medium-size spall core of chert, weighs 28.8 g and was found in XU 4. Catno 3024, a small bipolar core of petrified peat, weighs 22 g and was found in XU 5.

Faunal Remains (Tables 12.12, 12.13)

Bison, NISP=27: four upper teeth (dP^3, Dp^4, M^1, M^2; AG B), M_2 (AG 4?), cervical centrum, two thoracic centra, thoracic neural spine, four lumbar neural arches, intervertebral disk, rib shaft, proximal rib, two scapula blades, proximal humerus, distal humerus, proximal radius ©, front 2nd phalanx, ischium, distal femoral epiphysis ©, two tibia shafts, tarsal C+4 ♂. Only the tarsal, an adult bull, can be assigned gender. The radius lacks the proximal epiphysis and therefore represents a calf less than two years old. The same calf could have supplied the maxillary teeth that form a single tooth row assigned to age group B (long-yearling). The femoral epiphysis is from an animal less than five years old, possibly the same individual as the M_2 which is tentatively assigned to age group 4. Carnivore tooth furrowing is seen on both humerus fragments, on the proximal radius, and on the femoral epiphysis. Of eight weathered bones, the rib has reached Stage 2 and the one scapula blade has advanced to Stage 3.

Size 5-6 mammal, unidentified, n=65: 25 tooth, five vertebral, five rib, one scapula, 29 long bone shaft fragments. One long bone fragment has been gnawed by a carnivore.

Grizzly Bear, NISP=1: mandible (articular condyle).

Wolf, Dog or Coyote, NISP=1: ischium.

Rabbit or Hare, NISP=1: proximal humerus. This bone has a distinctive yellow-brown stain and has been pitted and thinned by digestion.

Ground Squirrel, NISP=3: mandible with all alveoli containing only the root of P_4, two proximal femora. Both femoral fragments were fractured when fresh, and all three elements have a distinctive yellow-brown stain.

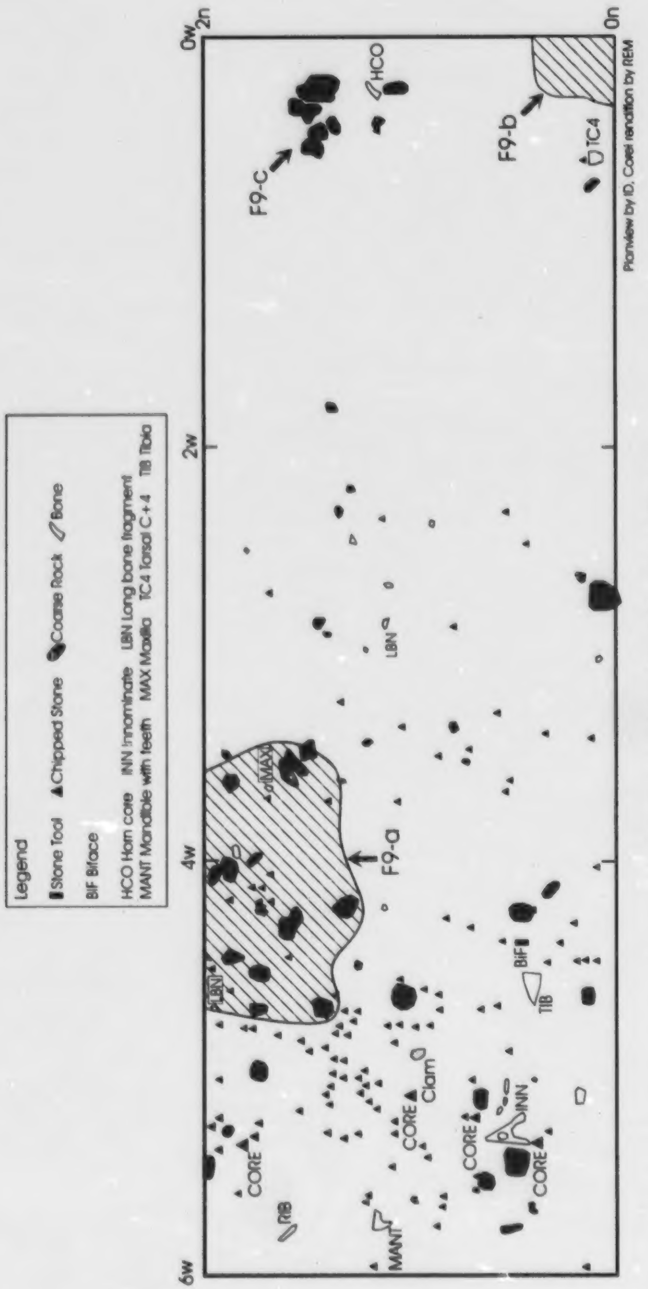
Size 3 mammal, unidentified, n=3: three long bone shaft fragments.

Unidentified mammal, n=800: fragments of which 772 are less than 4 cm long and the remainder are 4-10 cm long. Five specimens, all from XU 6, have been digested. Charred (37) and calcined (16) fragments are most abundant in XU 4 but occur in all three units.

Freshwater Clams: 17 pelecypod fragments were found — one in XU 4, four in XU 5, and 12 in XU 6.

Plant remains: Three charcoal fragments (0.3 g) were recovered from XU 4.

Discussion: Portions of an adult bison bull and at least one calf are represented among these remains, and there may be parts of a third bison that is intermediate in age. The calf, a long-yearling, suggests a spring or summer season kill. None of the carnivore tooth-furrows is large enough to suggest that the grizzly bear gnawed the bison bones. The leporid and ground squirrel bones probably originated in the loosely infilled (badger?) burrow first encountered in XU 4 in Layer IV-V.


Legend
▮ Stone Tool ▲ Chipped Stone ● Coarse Rock ⬭ Bone
BIF Biface
HCO Horn core INN Innominate LBN Long bone fragment
MANT Mandible with teeth MAX Maxilla TC4 Tarsal C+4 TIB Tibia
0w
2n
0n
2w
4w
6w
F9-a
F9-b
F9-c
HCO
TC4
LBN
LBN
MAX
CORE
CORE
CORE
CORE
Clam
INN
TIB
BIF
RIB
MANT

Planview by ID, Corel rendition by REM

Figure 13.1. Planview of Sjovold Layer IX.

Chapter 13

Layer IX: A Flint-knappers' Sweat Lodge

Introduction and Planview

Layer IX lies 135-141 cm BS at 2n2w and coincides with a very faint, intermittent, buried soil labelled Ahb7. Three features were exposed: one small surface hearth, a nearby concentration of coarse rocks thought to represent a sweat lodge, and a larger surface hearth surrounded by occupation debris. The occupation debris includes a fair amount of finely broken chipped stone and comminuted/weathered bone, some of which found its way into the interlayer below. However, no diagnostic material is included, and the occupation is culturally unidentified. The layer slopes downward from 2n2w to the west at about 17:400. The north-south slope was difficult to detect. Age is interpolated from dates on adjacent layers to be between 350 BC and AD 50 (cal 2200-1900 BP; Table 3.6). Interlayer IX/X was about 11 cm in thickness. During excavation we kept data for Layer IX and Interlayer IX/X separate in XUs 1-3. In fact, Interlayer IX/X was excavated in two levels. In subsequent analyses we apportioned these interlayer artifacts between Layers IX and X. In XUs 4-6, however, Interlayer IX/X was removed as part of a single excavation level that included materials from Layer VIII to the top of Layer X. Those materials have been described as a group in the previous chapter.

In addition to three features, the Layer IX planview (Fig. 13.1) shows the locations of one biface, four chipped stone cores, and six bison bones — horn core, mandible, rib, innominate, tibia, and tarsal C+4. There is also a small concentration of clam shell fragments just southwest of F9-a.

Features

Feature F9-a (Fig. 13.1, Table 13.1) was an open cluster of small, medium and large fire-broken rocks interspersed with bone fragments (several charred) and chipped stone, all resting on a 1-3 cm thick patch of ashy soil a little over a meter in diameter. The weight of coarse rock within the feature was about 8-10 kg. Adjoining to the west, south and east (the north side was not exposed), was a fairly dense surface scatter of chipped stone debris and broken bones. That apron of debris varied in width from about 0.5 m to about 1.5 m and seemed widest to the south and east. We interpret F9-a as a surface hearth used for general cooking and heating purposes. The absence of a deep underlying stain or burn can be explained as a consequence of using bison dung as fuel. It is not clear whether the fire-broken rocks within the feature were used as boiling rocks, roasting props, or some other purpose. It is even conceivable that the sweat lodge rocks of F9-c were heated in F9-a rather than F9-b. The few pieces of bone and chipped stone found within F9-a were probably tossed or dumped there.

Table 13.1. Features in Layer IX.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F9-a	surface hearth	175n405w	>75	135	1-7
F9-b	blackened soil	15n5w	50	>35	1-2
F9-c	rock cluster	145n35w	24	40	0-7

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

Those pieces are a dim reflection of the greater amount of debris, particularly of chipped stone, which was dropped around the hearth. Presumably the surrounding debris reflects fireside activities such as stone chipping and food consumption. There is also a hint of an overall circular configuration to the combination of hearth F9-a and its encompassing debris. A circular limit to the debris might correspond to the limit imposed by the walls of a dwelling such as a tent. If such a dwelling did cover that area, it may have had a diameter of about 4 m. However, given the limits of our excavation we were not able to see much of the surface beyond the suspected wall positions and, therefore, we urge caution in interpreting F9-a as the heart of a dwelling. The postulated use of bison dung fuel would not be expected inside a dwelling.

Feature F9-b was a small irregular patch of blackened soil coincident with the buff-grey occupation surface of Layer IX and situated in the southeast corner of XU 1. It was about 35x35x2 cm thick. About 25 cm west of F9-b were three objects in a small cluster: a cobble of fire-heated, spalled quartzite, a decortication spall of green-gold siltstone and a bison tarsal bone. About 60 cm to the north were a sandstone cobble and a large petrified peat flake, and just beyond that was a tight cluster of coarse rocks which we refer to as feature F9-c. There was a sparse scattering of 49 bone fragments and 14 pieces of chipped stone within XU 1 and in the general vicinity of F9-b. We suspect that F9-b functioned as a small hearth. Supporting evidence includes the blackened soil of F9-b, the heat-altered quartzite cobble to the west and the fire-broken rock in F9-b. Accordingly, F9-b could have been the hearth where some of the F9-c rocks were heated. The lack of an underlying stain or soil burn might be due to the use of bison dung as fuel. We admit that the evidence for this interpretation is equivocal in light of the small size of the feature, the lack of coarse rock fragments on or touching it, and the incomplete exposure of its eastern context. Considered in a different light, it is conceivable that F9-b resulted from a natural process such as windblown black soil being trapped in the foliage around the base of a plant. Because of this doubt, we decided not to express the hearth interpretation in the feature descriptor even though it is our best guess.

Feature F9-c was a tight oval surface grouping of seven medium to large rocks. It included three matching (but unarticulated) fragments of buff-gold quartzite (1665 g), 1 non-matching fragment of similar quartzite (513 g), two matching slabs of limestone (986 g), and 1 piece of gneiss (53+ g). The total weight of rocks is more than 3217 g. The quartzite fragments show the irregular fractures and colour shifts indicative of exposure to fire. The gneiss also has been fired. It is so crumbly that it has shed part of its granular surface during collection, handling and storage. The limestone may have been fired, one clue being that the rock split and slid apart after arriving in F9-c. The limestone also bears longitudinal incisions on one face, but we could not determine whether the incisions are natural or cultural. The overall arrangement of rocks had gneiss at the center, one of the matching quartzites overlapping from the north, the three other quartzites just to the west, while the two limestone slabs overlapped each other and were less than 5 cm to the east. The underlying soil was similar to the buff-grey sandy silt of the surrounding occupation surface, but had a slight grey/black hue in the immediate vicinity of F9-c. Some 20 cm to the south was a buff-coloured sandstone cobble with a small crushed area on its surface, apparently due to impact with another hard object. Near it was a large flake of petrified peat. There was very little other material around F9-c for a distance of about a meter. Then began, to the south and west, the scatter of bone and chipped stone on the fringes of the apron of debris encircling F9-a.

Feature F9-c could have been used for steaming or roasting something. The best possibility would seem to be a cluster of steaming rocks at the center of a sweat lodge. The chosen rocks seem far less than optimal for such a purpose and the absence of a containing pit would make this an atypical sweat lodge rock feature. However, its size, tight grouping and the number and weight of rocks would be consistent with such a function. The sparseness of other materials in the surrounding one meter area and the proximity of a potential rock-heating hearth, a little more than one meter to the south, are also supportive evidence.

Rock

Predominant coarse rock materials (Table 13.2) are granite (43% by weight), quartzite (23%), gneiss (18%) and limestone (7%). The granite, gneiss and sandstone are present in approximately the same proportions as their natural abundance in local sources. They were probably selected randomly. Almost all the granite, gneiss, quartzite and schist shows signs of have been fired. Even some andesite has the irregular fractures and colour shifts indicative of firing. Thus, use as fire stones would appear to have been the main function for coarse rock in this layer. It is noteworthy that quartzite is more than twice as abundant in this occupation as in local sources, and it appears to have been deliberately sought out. One large piece of quartzite, which is ambiguous with respect to firing, may have been coarsely chipped. When chipped stone debitage is included in picture, it becomes clear that quartzite was used both as a chipping material and as a fire stone. The sandstone in Layer IX does not seem to have been fired. Several pieces show areas of surface crushing, and these may have been used as hammerstones. The average size of Layer IX rocks is 103 g, about two-thirds of the site average (159.8), but much greater than the average for the three layers above — VI (25.1), VII (55.7) and VIII (32.1). Since the degree of disaggregation is moderate, it appears that the duration of occupation probably in the order of several days.

Table 13.2. Coarse rock from Layer IX.

	Number				Weight			
Material	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
amphibolite	-	3	-	3	-	6	-	6
andesite	-	1	1	2	-	3	14	17
basalt	1	-	-	1	2	-	-	2
chert	-	1	1	2	-	15	37	52
concretion	-	-	2	2	-	-	88	88
gneiss	3	8	6	17	590	829	1,494	2,913
granite	4	41	19	64	93	2,863	4,016	6,972
grano-gneiss	-	-	1	1	-	-	220	220
limestone	10	5	1	16	1,078	24	6	1,108
mudstone	-	-	4	4	-	-	2	2
quartzite	8	6	5	19	2,802	451	470	3,723
quartz	-	2	1	3	-	7	10	17
rhyolite	-	-	1	1	-	-	368	368
schist	-	-	1	1	-	-	302	302
sandstone	1	1	2	4	305	1	125	431
unidentified	6	10	1	17	5	24	2	31
Total	33	78	46	157	4,875	4,223	7,154	16,252

Stone Tools

Biface (n=1). One end of a medium-size biface (catno 1748, Fig. 13.2, Table 13.3) was found in XU 3 about 55 cm southwest of hearth F9-a. It is made of a mottled cream-orange-grey Swan River Chert. The fracture along which the piece was broken seems to have been due to impact on the edge, about 23 mm from the end, as if the tool had been used in a chopping motion. The bifacial edge has both straight and sinuous sections. It is well worn, a combination of light crushing and abrasion being apparent to a distance of about 1 mm on each side of the center line. This suggests that the main function was rough cutting and light chopping.

Endscraper (n=1). A small plano-convex endscraper (catno 1779) made from a split pebble of dark olive-brown silicified sediment was found in XU 1. Two adjoining edges have been well rounded and polished by use. Attempts to sharpen the edges were obstructed by an encroaching area of pebble cortex on one edge and by step fractures on the other. One presumes that failure to rejuvenate the tool led to its discard.

Projectile point preform (n=1). Catno 1485 has most of the characteristics of a triangular projectile point preform missing only the tip. It has the same slightly convex base, broad haft, proportion of thickness to length, and fairly rapidly converging sides as the side and corner-notched projectile points found in Layer X. It is made of a mottled orange-cream Swan River Chert and is bifacially thinned over the whole of both faces. The basal edge is slightly convex and has been ground or worn smooth. The lateral edges, also slightly convex, are sharp. The tip has broken along a hinge fracture through a crystalline vug at the center, apparently a snapping type of breakage. The degree of rounding and polish on the basal edge seems unusual for an otherwise unfinished projectile point. Perhaps the tip snapped while the basal edge was being used for scraping or cutting.

Projectile point (n=1). Catno 1803 is a basal fragment of notched projectile point with a well ground and slightly convex base. It is made of black silicified sediment and must have been a fine specimen before being broken. The fracture removed the blade from the top of the notches to the tip along a near vertical plane passing through the tops of the two notches. The same fracture turned 90° and ran along one face through the haft and, as it neared the base, it turned again, exiting through the opposite face and removing about three-quarters of the basal edge. The remaining piece includes about seven-eighths of one notch, its adjoining notch/basal juncture, an adjoining 5 mm segment of basal edge, a damaged mid-haft area extending to the opposite notch, and about one-fifth of that notch. The rest of the point is missing. This type of break is consistent with direct impact on the tip. Presumably, the dart or arrow to which it was attached was damaged when it struck something hard. The shaft was retrieved with the blade missing, but with the haft of the point still attached. It

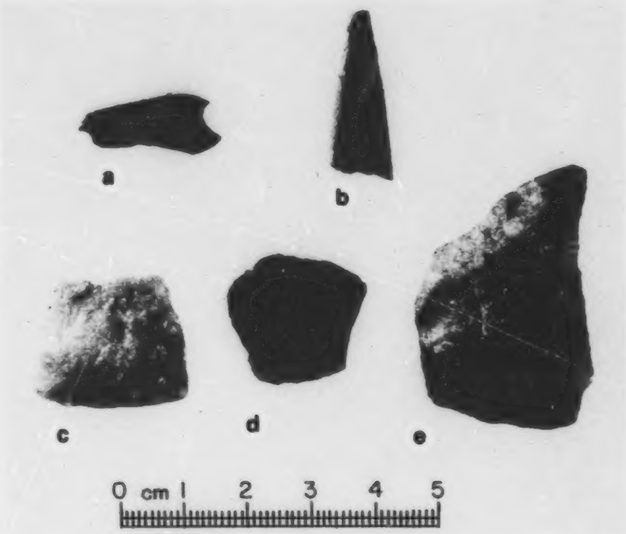


Figure 13.2. Tools from Layer IX. a, projectile point; b, bone awl; c, preform; d, endscraper; e, biface.

Table 13.3. Stone tools from Layer IX.

Type	Catno	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
biface	1748	3	14.9	27	40	10	Swan River Chert	n	13.2e
endscraper	1779	1	3.7	22	20	5	silicified sediment	y	13.2d
preform	1485	3	3.4	21	24	4	Swan River Chert	n	13.2c
projectile point	1803	3	1.1	5	22	4	silicified sediment	n	13.2a

Table 13.4. Chipped stone debris, excluding cores, in Layer IX.

	Number				Weight			
Material	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
agate	-	1	7	8	-	0.3	3.8	4.1
chert	-	2	9	11	-	2.6	29.6	32.2
Knife River Flint	1	1	-	2	1.6	0.0	-	1.6
petrified peat	10	218	320	548	37.2	344.6	406.7	788.5
petrified wood	-	16	29	45	-	32.7	28.7	61.4
quartz porphyry	-	-	1	1	-	–	1.7	1.7
quartzite	1	5	12	18	12.2	40.3	35.4	87.9
quartz	-	12	39	51	-	14.4	54.5	68.9
Swan River Chert	1	7	79	87	0.3	5.1	141.9	147.3
silicified sediment	1	3	11	15	3.8	4.2	8.6	16.6
Total	14	265	507	786	55.1	444.2	710.9	1210.2

Table 13.5. Chipped stone cores from Layer IX.

Type	Catno	XU	Weight	Size*	Material	Fig.
amorphous	1608	3	13.9	b	chert	13.3a
bipolar	1753	3	18.2	b	chert	13.3b
bipolar	1758	3	43.1	c	quartz	13.3c
bipolar	1759	3	62.1	b	quartz	13.3e
spall	1787	2	74.6	c	quartz	13.3d

* size refers to categories based on greatest length: (a) 13-25mm, (b) 26-49 mm, (c) 50-100 mm, (d) 100-149 mm, and (e) 150 mm and larger.

was brought to the site for repair, the haft section of the old point being discarded when the repairs were complete. There is too little left of the point to characterize its type. The notches appear to have been side notches set very close to the base. The base is slightly convex and well ground, consistent both with the preform found in the same unit and with some of the characteristics of projectile points in Layer X below.

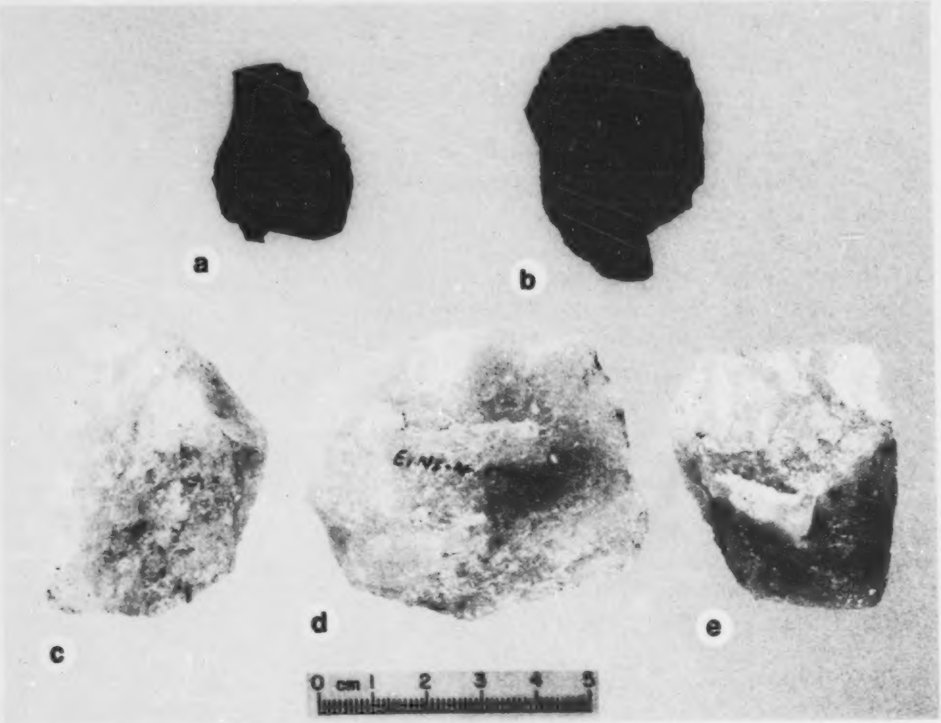


Figure 13.3. Chipped stone cores from Layer IX.

Chipped Stone Debris

The predominant chipping material (Table 13.4) is petrified peat (65.2% by weight), followed by Swan River Chert (12.2%), quartzite (7.3%), and quartz (5.7%). The petrified peat and quartzite indicate reliance on local river valley resources, while the Swan River Chert may be an indication of commerce to the northeast. The facility shown by Layer IX flintknappers in the use of quartz is unusual for this region and is reminiscent of boreal forest stone chipping where quartz use is more common. Exotic southern materials such as Knife River Flint are present in such small quantities that they could represent recycling of materials lost by previous occupants of the area. As to the degree of reduction, only quartzite was rendered into large-size debris (3 g or more per specimen). The great majority of materials were left as medium size debitage (1.0-2.9 g), specific average weights being chert (2.9), quartz porphyry (1.7), Swan River Chert (1.7), petrified peat (1.4), petrified wood (1.4), (quartz 1.4), and silicified sediment (1.1). Two materials were discarded only as small debitage —

Knife River Flint (0.8 g per specimen) and agate (0.5). Their presence probably represents the retouching of existing tools. Overall, debitage sizes indicate an emphasis on the middle phases of stone chipping. Evidently, a good deal of the work was oriented toward roughing out tools or preforms.

Quartz cores are of the bipolar and spall varieties; chert cores are either bipolar or amorphous (Fig. 13.3, Table 13.5). Once again it is curious that the predominant chipping material, petrified peat, was not represented by a single core.

Flakes, shatter and cores were concentrated in XUs 2 and 3 around hearth F9-a. A bifacial preform, a projectile point fragment and a biface fragment were in the densest part of this debris, while an endscraper was found on the sparser east edge of the concentration. All tool materials are represented by debris, but most debris materials (petrified peat, quartzite, quartz, petrified wood, Knife River Flint and others) are not represented among the tools.

Bone Tools

An awl made on an unclassified large mammal bone fragment was found in XU 3 (catno 1801, Fig. 13.2b). Only 26 mm of the tip was recovered, and this is so heavily etched by rootlets that longitudinal striations are visible only on islands of the original bone surface. No polish is apparent.

Table 13.6. Vertebrate remains from Layer IX.

	Number				Weight			
Size, Taxon	XU 1	XU 2	XU 3	Total	XU 1	XU 2	XU 3	Total
6, Bison	3	1	5	9	202.3	7.6	640.5	850.3
5-6, mammal	8	21	21	50	31.0	163.0	35.2	229.3
4, Beaver	1	-	-	1	2.8	-	-	2.8
-, mammal	37	132	78	247	20.6	115.4	57.2	193.2
Total	49	154	104	307	256.7	286.0	732.9	1,275.6

Faunal Remains

Some of the vertebrate remains from XU 3 contributed to a radiocarbon sample (S-1765), and the remainder are presented in Table 13.6.

Bison, NISP=9: horn core ♀, mandible with M_3 (AG 5), $I_?$, rib, acetabulum with ilium and ischium, proximal tibia ♀, tarsal C+4 ♀/©, proximal lateral sesamoid, proximal medial sesamoid. All of these elements could be parts of a single cow belonging to Age Group 5. The incisor is weathered

Table 13.7. Modified vertebrate remains from Layer IX.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	-	-	-	-	2	6	1	-	3	2	3	9
5-6, mammal	-	-	-	-	*	*	3	-	23	24	-	50
4, Beaver	-	-	1	-	-	1	-	-	1	-	-	1
-, mammal	1	25	-	1	*	*	-	*	*	*	-	247

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

to Stage 2.

Size 5-6 mammal, unidentified, n=50: three tooth, one maxilla, 23 rib, 23 long bone shaft fragments.

Beaver, NISP=1: tibia shaft. This bone has been gnawed by a carnivore.

Unidentified mammal, n=247: fragments less than 4 cm in length. One, from XU 3, has been shaped and used as an awl. Of 25 burned specimens, 22 are charred, and three are calcined; most of the charred bones were found in XU 2 where they were associated with Feature F9-a.

Snails: One small gastropod was recovered from XU 3.

Freshwater Clams: Ten pelecypod fragments were found in XU 2 (2) and XU 3 (8).

Discussion: Portions of a bison cow are represented in Layer IX. The beaver either was scavenged from among the campsite debris or was introduced to the site by a carnivore.

Interpretation of Layer IX

The focus of attention in Layer IX is surface hearth, F9-a, and its surrounding scatter of chipping and bone debris. The hearth contained thirteen medium and large fire-altered rocks and a small amount of chipped stone and broken bone debris. Evidently, the fire served multiple functions such as heating rock, warming and perhaps lighting the work of a fireside flintknapper(s), and as a disposal area for some of the chipped stone and bone debris generated at fireside. Since there is no subsurface stain or soil scorching and only a thin patch of ashy soil at the surface we presume that the fuel was bison dung. This would have produced a lot of smoke unless the dung was very dry or the fire well ventilated. A fairly large amount of stone chipping took place at the edge of the hearth, utilizing mainly locally available petrified peat and quartzite. Most of the work appears to have represented early and (especially) middle phases of stone reduction and tool making, but we have little knowledge of the actual tools or preforms made here since the predominant chipping materials were not represented among recovered tools. Two stone tools that were recovered — a broken biface and a thin bifacial preform — are kinds that we would expect from such chipping. A bone awl found among the fireside debris suggests a sewing function and underlines the multipurpose character of this activity area. There is a hint of circular shape to the outer perimeter of the fireside debris, possibly conforming to the walls of a circular dwelling such as a tent.

About 1.5 m east of F9-a hearth and its accompanying debris were two other features — a rock cluster, the hot rocks of a sweat lodge and a small patch of blackened soil that may represent a hearth on which the sweat lodge rocks were heated. There was little stone and bone debris in the general vicinity of these features and only one stone tool, an endscraper. The distance between the debris around hearth F9-a and the sweat lodge rock pit is within the range known for Plains Indian tipi and sweat lodge groupings (cf. Curtis 1980, Vol. 4:54; P. Dyck 1971:177, 191). However, since no other evidence for a dwelling was discovered, and smoke-prone dung seems to have been the fuel, the presence of a dwelling over F9-a is not certain.

The resources used by Layer IX occupants include local coarse rock, local petrified peat and quartzite for chipping, and a sparse sampling of presumably local game animals (perhaps just one bison and possibly a beaver). Given the low intensities of fired rock use, stone chipping, discard or loss of tools, and game consumption, the group of site occupants was likely small, perhaps only a single nuclear family. Moreover, their stay, while definitely overnight, was probably not longer than a few days. Although not directly dated, the age of this occupation is between 350 BC and AD 50 (cal 2200-1900 BP; Table 3.6). Unfortunately the archaeological complex has not been identified. The strong presence of Swan River Chert and the capable use of quartz as a chipping material point toward a group with boreal forest affiliations. Preform and projectile point comparisons indicate that Layers IX and X may belong to the same archaeological complex.

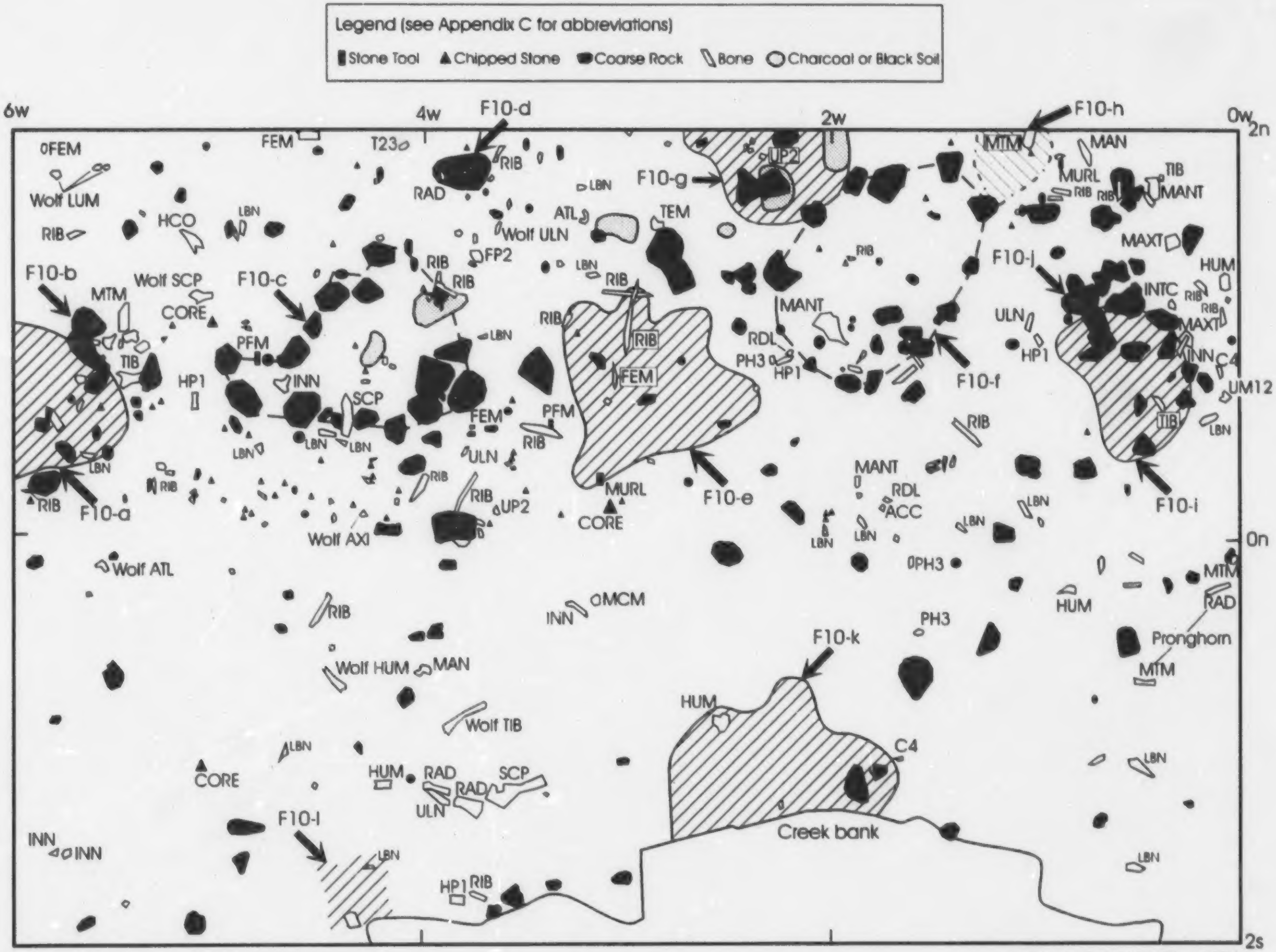
Chapter 14

Layer X: Besant/Pelican Lake Boiling Stone Operations

Introduction and Planview

Layer X, lies 152-165 cm BS at 2n2w. It is one of two layers for which we had simultaneous controlled exposure on both the "0" south and "2" south rows of excavation units, a total of about 23 square meters. The exposure contained 12 features and some 39 stone tools including Besant and Pelican Lake-like projectile points. There were also substantial quantities of chipping debris, coarse rock, and broken bone. The number of cobbles, small boulders, and pieces of coarse rock was unusually high. Surface undulations, some with an amplitude of as much as 8 cm over a span of 75 cm, were characteristic of this layer. From a high point at 2n2w the layer sloped downward to the west at about 21:400. To the south the slope was more gentle, about 1:100. Enclosing deposits continued to be buff/yellow/grey sands and silts, perhaps somewhat finer grained than in upper layers. Sediments within the layer were similar to enclosing sediments, making it quite difficult to locate the top and bottom limits of the occupation. In some places our profiles revealed a faint dusty grey colour marking the top of the layer, but elsewhere the layer blended imperceptibly into interlayers above and below. Anderson and Ellis (this volume, Table 3.2) have given the tentative label, C8, to the dusty grey horizon, noting that it may be a faint Ah horizon. There are three radiocarbon dates, two on charcoal and one on bone, which indicate an age of occupation between 350 and 150 BC (cal 2300-2100 BP; Table 3.6).

It was very difficult to determine where the bottom of Layer X was situated. A 1-10 cm thick zone (excavation levels 10-6, 10-7), which we thought would be Interlayer X/XI, contained new features that we were very surprised to see. A true interlayer should not contain such features. Possible explanations might be that: (1) the features were in a trough in Layer X; (2) they were on the crest of an undulation in Layer XI; or (3) they represent a phase of occupation separate from layers X and XI. There were no diagnostic artifacts in direct association with the "interlayer" features to resolve this question. Comparisons of chipping debris and radiocarbon dates also left us with equivocal results. However, one match among faunal remains between the Interlayer feature F10-e and Layer X feature F10-i suggests that interlayer features in that area belong to Layer X. Meanwhile, stratigraphic evidence (mainly extrapolated depth) has been used to assign an isolated feature in XU 6 to Layer XI. Thus, Interlayer X/XI remains have been apportioned to Layers X and XI. We wish to acknowledge the work of Lawrence Melit (1982) in studying the larger rocks of Layer X in an attempt to determine whether there was any pattern to their arrangement. Melit focused on four variables which did not lead to pattern recognition. Nevertheless, his work eliminated certain possibilities and, thereby, facilitated our search for suitable interpretations.


Legend (see Appendix C for abbreviations)
▮ Stone Tool ▲ Chipped Stone ● Coarse Rock ▱ Bone ○ Charcoal or Black Soil
6w
4w
2w
0w
2n
0n
2s
F10-a
F10-b
F10-c
F10-d
F10-e
F10-f
F10-g
F10-h
F10-i
F10-j
F10-k
F10-l
FEM
Wolf LUM
RIB
HCO
LBN
Wolf SCP
CORE
MTM
TIB
HP1
PFM
INN
SCP
T23
RAD
ATL
Wolf ULN
FP2
TEM
UP2
MAN
MURL
MANT
MAXT
HUM
INTC
ULN
C4
UM12
RDL
PH3
ACC
MCM
Wolf AXI
Wolf ATL
Wolf HUM
Wolf TIB
Pronghorn
Creek bank

Planview by ID. Corel rendition by REM

Figure 14.1. Planview of Sjovold Layer X.

Table 14.1. Features in Layer X.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F10-a	surface hearth	65n575?w	64	>35	0-6
F10-b	rock cluster	70n555w	90	65	0-14
F10-c	stone ring	93n424w	98	166	0-10
F10-d	stone anvil	180n380w	18	28	17
F10-e	surface hearth	150n285w	102	94	2-6
F10-f	stone ring	135n185w	100	130	0-9
F10-g	surface hearth	183n220w	>50	80	0-5
F10-h	clay patch	188n113w	>35	36	2-3
F10-i	surface hearth	80n50w	82	62	0-13
F10-j	rock cluster	105n60w	95	65	0-11
F10-k	surface hearth	145s200w	>50	>155	0-7
F10-l	blackened soil	180s435w	>36	45	3

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

The planview of Layer X (Fig. 14.1) reveals the locations of 12 features and a fairly dense scatter of coarse rock, bones, stone tools, and chipped stone debris. Abbreviations used for stone tools and bones are given in Appendix C. Bone labels given in a smaller type size represent unidentified size 5-6 mammals, whereas a larger type size represents bison bones unless otherwise marked. For example, there are two pronghorn bones near the east edge of XU 4, and a scatter of wolf bones is seen in the western half of the planview. Four stone artifacts, including two preforms and two MURLs, are seen in the west edge of F10-c, near the southwest corner of F10-e, and just east of F10-h. Of the concentration of bones shown in F10-b, only a bison tibia and a metatarsal are labelled, but the intervening smaller bones comprise a complete set of tarsals with the whole group representing the ankle assembly of a bull bison. The row of bones containing humerus, radius, ulna and scapula northeast of F10-l might appear to comprise one bison forelimb, but the humerus and scapula represent a very juvenile animal and the radius a nearly full grown but subadult bull (Table A2.7, catno 4045). Other aspects of the planview are mentioned in the descriptions and discussions of the features.

Features

Feature F10-a (Fig. 14.1, Table 14.1), a surface hearth, was partly exposed at the west edge of excavations. It was marked by patches of black, buff, mauve-buff and ashy soil in an area roughly 60 cm in diameter. Within the 1-3 cm thick surface layer were burned and unburned bone fragments, a few pieces of chipped stone debris and some small pieces of fired rock. Resting on top of the hearth and overflowing its margins was an open cluster, F10-b, of rocks and bones. Underlying was an irregular lens of blackened soil perhaps 5 cm in greatest thickness containing a few pieces of occupation debris. Surrounding F10-a to a distance of at least 50 cm was a scatter of broken bones, chipped stone debris, stone tools, and the odd piece of fired rock, all resting on a buff to buff-grey soil. About 25 cm east of F10-a was one edge of a ring of stones we have labelled F10-c.

Charcoal chunks were not recovered from the F10-a hearth. The underlying blackened soil was only moderately deep, but otherwise similar to the subsurface of hearths which did contain charcoal. Yet, evidence for mixing within the hearth could account for much of the subsurface colour. There was not a great deal of blackened soil or ash at the upper surface and what there was seemed patchy. These attributes are like those one might predict for a bison dung fire. On the other hand a combination such as mixing during use and post-occupation weathering might account for a similar result with a wood fire. Thus, it is not clear what fuel was used in F10-a. A major purpose for the fire seems to have been rock heating (see F10-b). The hearth was also the focus of a surrounding multipurpose activity area where bones were broken, and stone tools manufactured or repaired, used, worn out and discarded. By the presence of both projectile points and endscrapers around the feature we infer that activities usually associated with both men and women occurred in this area. Feature F10-a also served as a minor disposal area for debris from activities around it, as evidenced by the few pieces of chipped stone and bone it contained.

Feature F10-b was an elongated triangular cluster of large, medium and small rocks and bones spanning the east end of F10-a. At least 14 rocks weighing about 14.8 kg were included. Most are granite and most have crumbly surfaces indicative of fairly intensive firing. The larger pieces tended to be on the peripheries of the hearth, particularly at the northeast corner, resembling the remains of a charge of coarse rock resting at one side of the hearth after heating. In that position they could have been picked up with tongs for use in another feature, such as F10-c, or kept warm until they were needed. The movement of rocks into the hearth for heating could account for the mixing and subsurface deposition of a few pieces of debris. Wet rocks just retrieved from the stone-boiling process might also be placed at the edge of a fire to dry before being reheated (Binford 1978:159). Bones found among the larger pieces of rock comprise a complete ankle assembly from a bull bison extending from distal tibia through proximal metatarsal. Opposing impact scars on the metatarsal suggest that the rocks also served as hammer and anvil for marrow extraction or for preparation of soup bones.

Feature F10-c (see Fig. 14.2) was an irregular ring of 24 rocks, altogether a little over a meter in greatest dimension, situated just east of F10-a and F10-b. Two rocks at the west end of the feature seem out of alignment and create a 30 cm distortion on what would otherwise be a circular ring of stones. There was also a clustering or double row of rocks at the east end of the ring and a gap of about 30 cm in the northeast quadrant. More than half the rocks are large; most of the rest are of medium size. The total weight is more than 43 kg with a range of 200-6,800 g and an average of 1,804 g. Most of the rocks are whole cobbles or large fragments of granite, and few show any sign of having been fired. There were a few fragments of bone and chipped stone among the rocks, and a few more in the void at the center. All of the rocks appeared to be resting on the occupation surface which was buff to buff-grey and dotted with specks of white carbonate. There was a patch of slightly

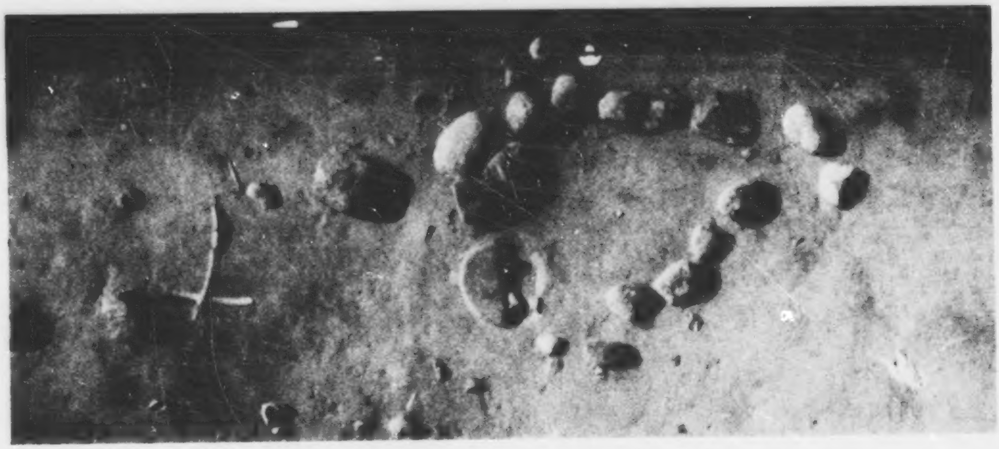


Figure 14.2. Stone ring F10-c viewed from the north. Hearth F10-e, beneath the crossed ribs to the left, is not yet exposed. RSM #EiNs-4:80-103 CT.

darker grey soil within the "gap" in the circle. It was about 25x20x1 cm and may have been nothing more than the usual mottling of the occupation surface. A fairly dense scatter of broken bones and chipping debris, sprinkled with occasional stone tools and fire-broken rocks occurred within a 50 cm wide band extending from the northeast corner of hearth F10-a to the west end of the circle and around the south side. About 50 cm from the northeast corner was a large rock surrounded by bone and chipped stone debris which will be discussed as F10-d.

We can think of three possible functions for F10-c: (1) weights for a stack of hides; (2) a shallow boiling pit; or (3) an above-ground boiling basin. Each will be considered in turn. Binford (1983:132-134) describes and illustrates such weighted hide features at an Eskimo hunting stand in Alaska where caribou hides were laid out to dry and weighted with stones to keep them from blowing away. His examples were situated in "craft" areas and were at least 10 m or more from any hearth. Moreover, such features utilized smaller stones and were more disrupted than those in F10-c. This analogy does not fit well with the evidence from F10-c.

A more likely possibility is that F10-c was a shallow hide-lined boiling pit, the edges of the hide being weighted with stones. Kroeber (1902:25) described an Arapaho stone-boiling pit of this type: "Meat was boiled in rawhide. A hole was made in the ground, and rawhide pressed down into it, its edges being weighted down with stones. The sack-like rawhide was then filled with water, which was made to boil by means of heated stones." The size of the F10-c ring, the weight of the stones, and the proximity to a stone-heating hearth all support the boiling pit analogy. It is quite plausible that the rocks (and rawhide) could have been left in place as we found them after the boiling function was abandoned. Even the broken bones in the vicinity are supportive. The only missing evidence is some sign of a pit within the circle. Although it might be argued that a shallow pit might be made in this particular soil without leaving much sign, we have excellent photographs for critical stages of this feature's excavation and feel confident in saying that there was no sign of a pit.

A third possibility, and our preference, is a shallow above-ground boiling basin in which a rawhide was draped over a circle of stones whose height created the depth of the basin. We have not located an ethnographic analogy for this type of boiling operation and have simply imagined it in order to account for the apparent lack of a pit. The edges of the hide might have been pegged to the ground. Indeed, such pegging could have been reinforced with several additional stones. That would account for the two stones set back from the ring on the west and the several stones making a concentric outer arc on the southeast. Some of the stones might have been pushed out of the ring after abandonment, for example in the gap. One might resort to such a boiling basin if one had no knife or stick to dig a hole, or if the ground was very hard (possibly frozen), or if one were anxious to prepare a meal and appropriate stones were easy to obtain.

Feature F10-d consisted of a small grano-gneiss boulder (8,175 g) around the base of which were scattered bone fragments (some charred), and a few pieces of chipped stone and fired rock. The scatter extended in all directions to a distance of about 30 cm and included a smooth quartzite pebble weighing approximately 500 g at a distance of about 12 cm southeast of the boulder. We interpret the feature as an anvil on which bones were broken, perhaps using the small quartzite cobble as a hammerstone. It is possible that the same boulder served as an anvil for stone chipping. We note that the boulder sat opposite the gap in F10-c and that its basal shape and size were similar to that of the dark patch of soil seen in the gap. One wonders, therefore, whether the boulder was at one time part of the ring.

Feature F10-e was a surface hearth situated between two rings of stone. In planview it had an irregular shape with a greatest dimension measuring about one meter. The soil at its center was black; toward its perimeters the soil was more patchy and diffusely coloured - mauve-grey, black and buff. There were two small pieces of fired rock resting on the surface. Beneath the surface was a lens of black-brown soil, up to 5 cm thick at center, containing pieces of charcoal, fired rock and chipped stone debris (see Fig. 14.3). The rock included 124 small pieces weighing a total of 1,545 g; chipping debris included 25 pieces (no cores) weighing 83.6 g. There was also one stone chopper (catno 4223) in the subsurface portion of the hearth. Some 15 cm beyond the northeast edge were two large rocks weighing 2,700-3,000 g each. Two large fragments of bison ribs were also noted in this area along with several smaller pieces of bone and coarse rock. There was one large rock (5,500 g) within 15 cm of the western perimeter of the hearth. There, the hearth touched the scatter of surface debris which formed an arc around stone feature F10-c. Indeed, some of that debris may have been associated as much with this hearth as with the stone circle.

The fuel used in F10-e included, and perhaps consisted of, wood. Dr. R.J. Mott (pers. comm., 1990) examined the numerous pieces of charcoal from this hearth and identified only one taxon, *Prunus* sp. (plum or cherry). *Prunus virginiana* (chokecherry) is a prominent part of the "shrub layer"

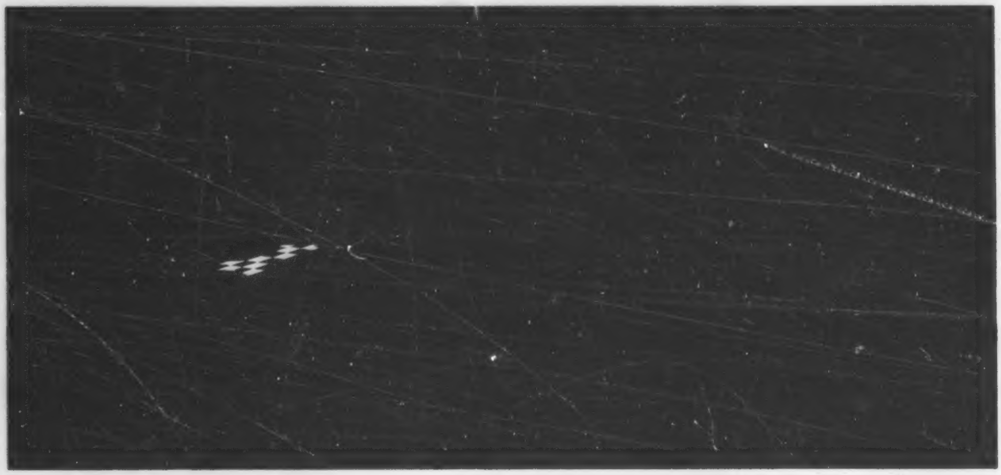


Figure 14.3. Profile of hearth F10-e viewed from the southeast. RSM #EiNs-4:80-152 CT.

in the Green Ash - Manitoba Maple forest bordering the site today (Abouguendia, et al. 1981). The presence of fired stone debris in the subsurface lens indicates that heating of stones took place in this hearth. The few pieces on top and the several large rocks on the margins are also indicative of this process. However, not nearly so much rock was left on F10-e as on hearths F10-a and F10-i. Perhaps the roasting function ended sooner here than at the other hearths, and the supply of hot rocks was allowed to dwindle without replenishment. Alternatively, perhaps the charge of hot stones from F10-e was taken for use in the other hearths. In any case it seems likely that an important function of F10-e was stone-heating in support of nearby boiling rings, F10-c and F10-f.

Even though a connection between this hearth and the boiling rings seems likely, we have not yet cross-matched artifacts to secure their functional relationship. Yet, we did find a connection to another feature. A row of left maxillary bison teeth assigned to age group C (catnos 4201, 4202) was found in the subsurface of hearth F10-e. A matching right tooth row from a bison of the same age (catno 3954, 3957) was found among the debris just north of hearth F10-i. The two tooth rows are closely matched in size and wear characteristics. Therefore, it seems highly likely that they belonged to a single animal and that F10-e and F10-i were contemporaneous. Hearth F10-e also served as a disposal area for chipping debris and broken bones. The concentration of such materials in this case was slightly greater within the hearth than on its immediately surrounding peripheries.

Feature F10-f was an oval ring of stones measuring about 130 cm east-west and 100 cm north-south. The ring was comprised of 26 large, medium and small rock fragments weighing a total of 30.5 kg. The weight range is 150-6,800 g per specimen, and the average is 1,175 g. Most of the rock is granite with firm cortical and fracture surfaces indicating minimal contact with fire, although a few pieces are crumbly and have definitely been fired (Melit 1982). The ring rested on buff to buff-grey soil typical of the occupation surface. There was no evidence for an internal pit, but there was a small amount of broken bone and chipped stone inside the ring, especially toward the peripheries. More broken bone and a quartzite biface were clustered among the stones on the south side. Touching the northwest corner was the F10-g hearth which we suspect was not in contemporaneous use. Touching the northeast corner was the F10-h patch of clay. About 50 cm to the east was the F10-i hearth and its charge of fired rock. The surface surrounding F10-f contained only a sparse scatter of occupation debris including several large shaft segments of bone. The characteristics and context of F10-f are similar to those of F10-c, and it probably served the same purpose, namely, as the rim of an above-ground boiling basin.

Feature F10-g was a surface hearth, apparently about 70-80 cm in diameter, which was partly exposed on the north side of our excavations. Its surface layer was about 0-3 cm in thickness and was marked by a patchwork of black and ashy-mauve soil. Chunks of charcoal recovered from its surface suggest that it was fuelled with wood. Resting on the hearth were (at least) one small and three large rock fragments with very crumbly surfaces. They have evidently been subject to intense firing. Underlying was a diffuse lens of light grey-mauve soil perhaps 3-4 cm in thickness. Only under the most intense patch of surface charcoal was there also a blackened part in the subsurface lens. Touching the southeast edge of the hearth was the F10-f ring of stones. About 50 cm to the east was a small patch of clay, F10-h. A little over a meter to the southeast was another hearth, F10-i, containing a heavy charge of fired rock, F10-j.

F10-g was evidently a wood fire that burned quite intensely for a short time. It served to heat several rocks for a function such as stone-boiling. It is doubtful that this hearth was contemporaneous with the stone ring touching it, because the horizontal proximity of the two features seems too close. Judging by the spacing it is more likely that F10-e or F10-i were the hearths that supplied the F10-f boiling ring with hot stones. If this inference is correct, then there was more than one episode in the occupation of Layer X.

Feature F10-h was a patch of platy yellow-grey clay that was partly exposed near the northeast corner of XU 1. The clay blended well with the colour of the occupation surface, but its texture was quite different from that of surrounding sandy-silt matrix, a difference that we felt immediately with our trowels. F10-h was about 38 wide, 3 cm thick and at least 35 cm long. The exposed part had a tear-drop shape with the broad end to the north, truncated by the limit of excavation. There was a single bone shaft fragment embedded in the clay near the north limit of excavation. The pointed end of F10-h touched the stone circle, F10-f, at its northeast corner. About 50 cm to the east was a small cluster of fired rock and bison teeth. About 65 cm to the southeast was the F10-i hearth with its heavy charge of fired rock. It is conceivable that the clay was a natural part of the deposit left by river flooding. If that was so, one wonders why it was the only such deposit encountered in Layer X. Thus, we are inclined to suspect that it had a cultural origin, but we cannot guess why it was created.

Feature F10-i was a small, well-preserved hearth situated near the northeast corner of XU 1.

In planview it was oblong, measuring about 90 cm northwest to southeast by 45 cm northeast to southwest. Its central area had been dished out to a depth of 4-5 cm and that area was infilled with the same buff brown sandy-silt that buried the occupation. The fringe was marked by a charcoal-infused soil. Underlying the dished surface was an 8 cm thick lens of black-brown soil containing small pieces of charcoal, at least 13 fragments of fired rock, 41 pieces of chipped stone debris, and numerous bone fragments, some calcined, some charred and some barely affected by fire. The surface of this hearth was crowded with coarse rock especially toward the north end and a short distance beyond (see F10-j). There was a small open cluster of rock, bison teeth and a couple of stone tools about 25 cm farther north. The F10-f stone ring lay about 55 cm to northwest. The limit of excavation was about 25 cm to the east. There was a sparse scatter of broken bones, chipped stone debris fragments of coarse rock and the odd stone tool around the south half of the feature.

F10-i, though a hearth of modest dimensions, was evidently used to heat a substantial amount of coarse rock. The burial and retrieval of rocks among coals at the center is indicated by the dishing of the hearth surface and by the mixture of rock and other debris in what would normally have been undisturbed subsurface. We infer that the fuel was wood from the presence of charcoal in the mixed subsurface, jet black soil at the fringes, and the black-brown subsurface matrix. This hearth also served as a disposal area for a fair amount of bone and chipped stone debris, forming a denser concentration than in the immediately surrounding area. Thus, activities which produced bone and chipped stone debris were either not situated immediately adjoining the hearth, or they were situated beside the hearth with the occupation surface covered in such a way that debris was not allowed to settle there. In any case the hearth debris shows that more than stone heating took place in the general vicinity of this feature.

Feature F10-j comprised a substantial charge of coarse rock lying across the northern part of hearth F10-i. At least 25 rocks, not including pieces smaller than 25 mm in diameter, were included. Almost all of it is granite. The rock surfaces vary from firm but fractured to very crumbly, with a large proportion being very crumbly. Evidently these rocks have been subjected to intense or repeated firing. Their total weight is a little more than 20 kg, the range being 150-2,270 g and the average being 801 g. According to experiments by Wendt (1988) this amount of granite heated to 600° C and then dipped into water could be expected to heat 20 liters of water from just above freezing to the boiling point. The distribution of rocks on this hearth was similar to that on F10-a, but denser. The same sparseness toward the center and concentration toward the perimeter, particularly toward one end, was evident. Presumably, F10-j was a holding position for heated rocks awaiting use in the boiling process, or for rocks that had been used for boiling and were drying beside the fire in preparation for another heating cycle.

Feature F10-k was a surface hearth perched on the creek bank. Its south side was intercepted by our test profile and had been somewhat truncated by creek bank erosion. Its west side had been removed by excavation of a medium-size animal den which had been refilled with buff-coloured sandy silt. The surface of the hearth was marked by a diffuse mottled ashy-grey soil which faded into the surrounding buff-grey occupation surface. The hearth surface looked much blacker when it was damp. There was one medium-size (680 g) and one small (225 g) rock resting on the east side and a couple of small pieces toward the west. A bison humerus was found on the north side and a couple of bone fragments near southeast and western edges. We also found four stone tools on the hearth, 2 endscrapers and 2 MURLs. Underlying was a lens of sooty black soil 0-8 cm in thickness. It contained chunks and twigs of charcoal, a small sample of fired rock (43 pieces, 174 g), some fine stone chipping debris (24 pieces, 23.4 g) and a few teeth and bone fragments, some of them charred, some calcined. A zone of almost debris-free surface encircled the hearth to a distance of about 50 cm. There was one large stone (3,200 g) beyond the north east edge. A cluster of large bison bone fragments (scapula, humerus, etc) was situated to the west, just beyond the area removed by the animal den. A little farther west was the dark patch of soil that we labelled F10-l.

The mixture of occupation debris in the subsurface lens indicates that the hearth surface had been disturbed during use, perhaps due to burial and retrieval of roasting stones in the coals. The fuel used was wood. R.J. Mott (pers. comm., 1990) has identified *Prunus* sp. (chokecherry?) or *Acer negundo* (Manitoba maple) among the chunks and *Salix* sp. (willow) among the carbonized twigs. Wood of all three types can be found within a few meters of the site today. The chipping debris and stone tools indicate that the hearth was also used as a disposal area. The tools reflect hide scraping and cutting activities. Why the hearth was so close to the creek bank is puzzling. One might speculate that the creek was a little farther to the south during the occupation. However, the row of hearth and boiling features parallel to the modern bank and just a bit more than a meter to the north makes us think that the creek was really not far from its present position. Another possibility is that persons using this hearth were not of the same status as those at the hearth and boiling ring group and were thus forced to one side. An apprentice to a men's hunting group or war party might be an example. Another possibility is that activities carried out in conjunction with this hearth required close proximity to the creek. Possibly the cutting of meat and preparation of hides took place nearby. We have not been able to refit debris fragments from this hearth with pieces from any other feature and, therefore, have not established whether it was contemporaneous with the other features. We did notice that obsidian seemed to be confined to this hearth. Other materials were quite conformable with types that appeared elsewhere in the occupation. Our suspicion, in the end, is that F10-k probably is generally contemporaneous with the other features.

Feature F10-l, a patch of grey-black soil, was partly exposed in the southeast corner of XU 6. The exposed portion formed a rounded rectangle about 35 x 45 cm in plan and about 3 cm in thickness. There were two bone fragments on its surface, but the adjoining surface to the west, north and east was void of cultural remains to a distance of about 35 cm. Beyond that was a sparse to moderate scatter of debris, mainly broken bones and a few coarse rocks. Hearth F10-a was about 250 cm northwest. The creek bank was about 40 cm to the south. F10-l may have been part of a hearth; or it may have been a discard area for charcoal and ash from a hearth set farther back from the creek bank; or it may have had an origin that we have not guessed. Lacking the full context we can simply note its presence.

Table 14.2. Coarse rock from Layer X.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
amphibolite	19	1	9	-	-	-	29
andesite	13	12	24	1	3	5	58
anorthrosite	-	-	-	-	2	-	2
basalt	15	9	5	2	1	1	33
chert	-	-	1	1	-	-	2
concretion	39	5	-	-	3	-	47
diabase	-	-	2	-	-	-	2
gneiss	12	9	11	7	11	3	53
granite	135	183	110	21	26	10	485
grano-gneiss	-	-	12	-	-	-	12
greywacke	1	-	3	-	-	-	4
limestone	13	29	32	3	6	6	89
mica schist	47	2	-	2	-	-	51
mudstone	-	7	6	-	-	-	13
quartz	2	4	-	1	1	-	8
quartz porphyry	2	-	-	-	-	1	3
quartzite	8	10	9	-	6	10	43
sandstone	-	12	9	2	7	2	32
schist	-	2	-	-	1	-	3
shale	-	1	-	-	-	-	1
silicified sediment	4	8	12	1	4	1	30
syenite	2	2	-	-	-	-	4
tuff	1	-	3	-	-	-	4
unidentified	27	68	27	3	9	-	134
Total	340	364	275	44	80	39	1,142
Weight							
amphibolite	507	1	7	-	-	-	515
andesite	83	78	36	1	88	9	295
anorthrosite	-	-	-	-	17	-	17
basalt	64	70	67	26	115	46	388
chert	-	-	5	16	-	-	21
concretion	23	13	-	-	389	-	425
diabase	-	-	9	-	-	-	9
gneiss	1,236	350	981	260	316	280	3,423
granite	39,170	58,953	37,852	7,005	4,293	2,432	149,705
grano-gneiss	-	-	305	-	-	-	305
greywacke	97	-	27	-	-	-	124
limestone	1,190	59	1,240	913	8	1,135	4,545
mica schist	73	26	-	20	-	-	119
mudstone	-	43	306	-	-	-	349
quartz	214	8	-	159	1	-	382
quartz porphyry	56	-	-	-	-	78	134
quartzite	1,567	3,934	755	-	560	698	7,514
sandstone	-	443	2,583	2,043	91	212	5,372
schist	-	90	-	-	13	-	103
shale	-	*	-	-	-	-	0
silicified sediment	12	1	7	*	6	*	26
syenite	36	*	-	-	-	-	36
tuff	16	-	8	-	-	-	24
unidentified	665	310	255	1	18	-	1,249
Total	45,009	64,379	44,443	10,444	5,915	4,890	175,080

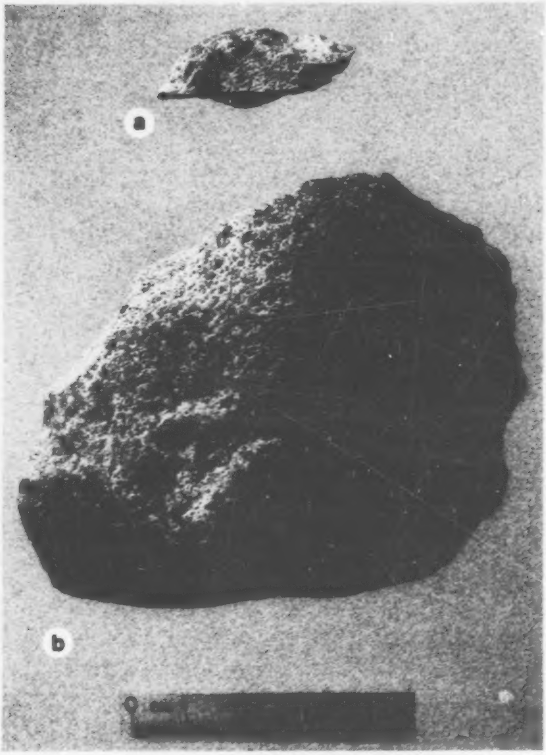


Figure 14.4. Biface (a) and chopper (b) from Layer X.

Rock

Granite is by far the most common rock type in Layer X (Table 14.2) comprising 85.5% of the total by weight. Other materials with a showing above 1% are quartzite (4.3%), sandstone (3.1%), limestone (2.6%) and gneiss (2.0%). Analysis of material types for this layer is a mixture of two people's work. Melit (1982) did a special study of the large pieces; Dyck subsequently analyzed the rest. The two groups of data have been merged in Table 14.2. Melit's definitions of rock types were slightly different from Dyck's; his "granite" includes Dyck's "granite," "gneiss" and "grano-gneiss." The rest of the definitions are essentially the same. There are abundant sources of "granite" all round the site, yet the combined natural abundance of granite (36%), grano-gneiss (14%) and gneiss (20%) (Dyck 1990) is still less than the percentage of "granite" in Layer X. Therefore, in spite of the variations in definitions, it is clear that occupants of Layer X were selecting granite (or the granite-gneiss group) over most other materials. Much of the granite in Layer X is also unusual for its state. Though a portion is clearly fire-broken, an even larger portion appears as whole or near-whole cobbles. The average weight for granite was 309 g per piece, an unusually large amount. Moreover, Layer X is one of the few layers in which granite was not used primarily as fire stones.

Other coarse rock materials in Layer X tend to be much smaller or more fragmented. Pieces of tuff and andesite have already been mentioned as materials that could be considered as chipping debris, although a significant amount of those materials, particularly andesite and basalt, also show exposure to fire. Quartzite, sandstone, schist and limestone appear to have been collected approximately in proportion to their local abundance. A high proportion of these materials has been fired. Once again it is interesting to note that quartzite was used both as a chipping material and as a fire stone. Traces of other rock materials may have been due as much to slope wash as to collection by occupants.

Stone Tools

Biface (n=1). Catno 1908 (see Fig. 14.4; Table 14.3) is an end piece of a large, apparently ovoid, biface. The surviving edge segment is sinuous. It has been dulled mainly by crushing or pounding, but with added wear due to abrasion as might be expected from use as a rough cutting instrument. This piece has been broken from the parent tool along a hinge fracture that indicates a snapping break as if the tool has also been used as a lever or pry.

Chopper (n=1). Catno 4223 is a decortication spall from the end of a metamorphosed sandstone cobble (see Fig. 14.4). Except for one thick blunt portion (the striking platform for the spall) the perimeter is moderately sharp. The sharp edge (about two thirds of the perimeter) shows occasional large flake scars on both faces plus signs of light crushing along the sharpest segments. These characteristics are consistent with use as a chopper on a medium hard substance such as skin and connective tissue.

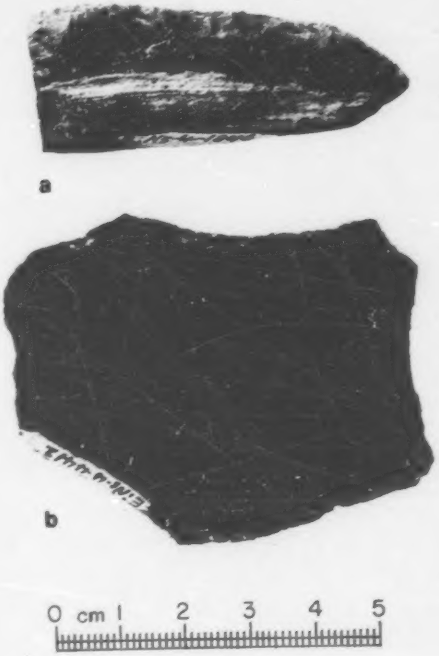


Figure 14.5. Knife scraper (a) and concave scraper (b) from Layer X.

Concave scraper (n=1). Catno 4412 is a large thin spall of dark grey andesite (see Fig. 14.5). On each of two adjoining edges is a broad concavity formed by crushing or crude retouching. Once formed these edges were further rounded and smoothed by transverse application against a fairly firm convex surface. A possible use for such edges may have been to break or remove the periosteal sheath enclosing bones. Such an action would facilitate bone breakage for marrow retrieval.

Endscrapers (n=10). Endscrapers from Layer X are a motley group of tools (see Fig. 14.6). Three of them (catnos 3636, 3795 and 4280) are made on medium-thick to thick expanding flakes which, in comparison to many other Plains Indian endscrapers, one might rate as having had only moderate potential for such use. Two specimens (catnos 3669 and 4286) are made on cortical flakes from split pebbles. Here, one might judge the choices of material to be good and mediocre, respectively. There are three others (catnos 3882, 3905 and 3907) made on pieces of shatter with edge use that was opportunistic and workmanship that was minimal. Catno 4347, perhaps the best of the group, is made on a cortical spall of fine toffee-like material that resembles Knife River Flint except

Table 14.3. Stone tools from Layer X.

Type	Catno	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
biface	1908	3	3.9	38	16	8	tuff	n	14.4a
chopper	4223	2	222.0	97	95	30	sandstone	y	14.4b
concave scraper	4412	3	29.6	71	50	7	andesite	?	14.5b
endscraper	3636	3	1.5	22	14	5	chert	n	14.6b
endscraper	3667	3	2.0	22	21	3	petrified wood	n	14.6d
endscraper	3669	3	2.4	24	18	3	silicified sediment	y	14.6c
endscraper	3795	5	3.4	26	19	6	chert	y	14.6f
endscraper	3882	6	10.9	35	25	10	Swan River Chert	y	14.6h
endscraper	3905	6	3.1	23	21	4	Knife River Flint	y	14.6e
endscraper	3907	6	3.4	26	23	6	Knife River Flint	y	14.6g
endscraper	4280	5	1.2	17	17	4	obsidian	n	14.6a
endscraper	4286	5	12.9	43	22	11	agate	y	14.6j
endscraper	4347	2	7.5	39	20	7	Knife River Flint	y	14.6i
knife scraper	1846	1	9.1	60	23	5	petrified wood	?	14.5a
MURL	1853	1	2.1	20	18	5	chert	n	14.7d
MURL	3281	1	0.8	27	10	3	Knife River Flint	y	14.7b
MURL	3385	2	1.7	18	18	5	chalcedony	n	14.7c
MURL	3559	1	3.4	30	14	11	chert	y	14.7h
MURL	3586	2	9.3	37	25	10	Swan River Chert	n	14.7f
MURL	3703	2	4.0	29	26	5	Swan River Chert	n	14.7g
MURL	3822	5	10.7	45	35	5	petrified peat	y	14.7k
MURL	3962	1	2.1	23	20	3	Swan River Chert	y	14.7e
MURL	4114	1	13.7	38	56	7	petrified peat	y	14.7j
MURL	4285	5	3.4	33	23	3	Swan River Chert	?	14.7i
MURL	4291	5	1.0	22	20	3	silicified sediment	n	14.7a
MURL	4431	5	38.9	64	39	10	quartzite	y	14.7l
perforator tip	3558	1	0.2	16	8	3	silicified sediment	n	14.8j
perforator	4333	1	0.5	20	13	3	Knife River Flint	y	14.8k
perforator	4343	2	11.7	51	21	10	quartzite	y	14.8l
preform	3330	2	5.2	30	23	5	silicified sediment	y	14.8h
preform	3470	3	2.9	30	19	4	petrified peat	y	14.8i
preform	3906	6	1.8	25	17	5	petrified peat	y	14.8g
projectile point	1847	1	1.9	27	19	4	petrified peat	y	14.8c
projectile point	1848	1	2.4	28	18	3	jasper	n	14.8d
projectile point	1907	3	0.4	4	17	4	jasper	n	14.8f
projectile point	3311	2	0.6	14	12	4	Knife River Flint	n	14.8e
projectile point	3598	2	1.3	21	17	3	petrified peat	y	14.8a
projectile point	3670	3	2.8	28	23	4	Knife River Flint	y	14.8b

that it has white, black and rusty-orange inclusions. It is elongate with steeply retouched (and step-fractured) sides. The end has long broad retouch flake scars on the dorsal face that give its edge a relatively shallow angle of about 60°. Thus, the end had been successfully sharpened a short time

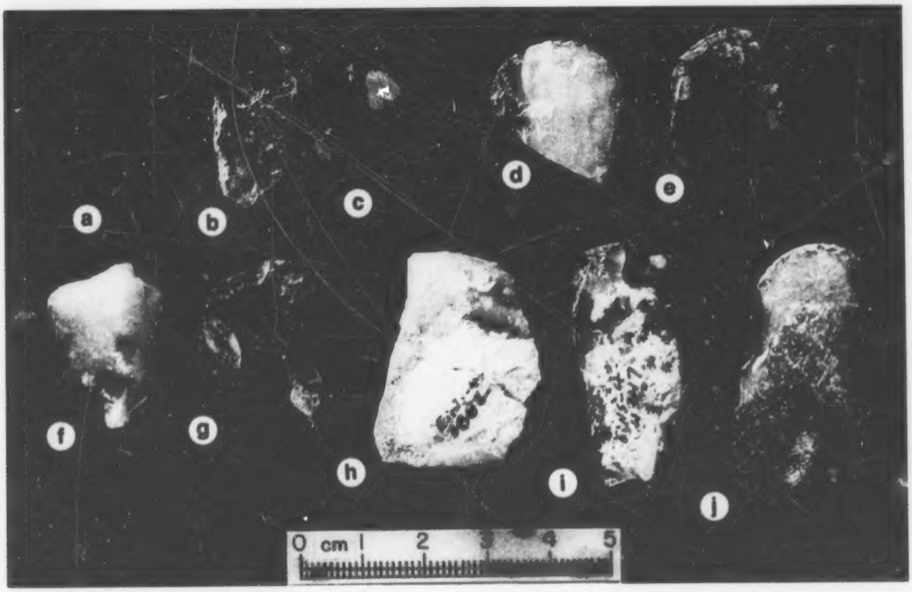


Figure 14.6. Endscrapers from Layer X.

before the item was lost or discarded. There is little sign of wear on the sides, but the end edge is moderately rounded, polished and transversely incised. We infer that the distal end had some scraping use after sharpening. The last of the group (catno 3667) is made on a broad spall of undetermined origin. It is quite well worked, though very thin, and apparently was broken in use. Three of the endscrapers were broken from side to side, presumably because they were too thin to withstand normal scraping pressures on their distal ends. Thus, catnos 3636 and 4280 consist of proximal ends of scrapers for which the distal (working) end is missing. Catno 3667 is the opposite, a piece consisting of a working end and midsection while missing the proximal end. All five endscrapers (catnos 3636, 3667, 3669, 3795 and 4280) whose side edges were amenable to use have signs of light retouching and/or use wear on those side edges. In one case (catno 3669) the sides are retouched on the dorsal face while the distal end is retouched on the ventral face. All others are retouched solely on the dorsal face. In general, this group of endscrapers has the appearance of inexpert manufacture. We suspect that it could be a group of tools normally used by women but in this case made and used by men or boys. All of the endscrapers were located in the west half of excavation, particularly in and around hearth F10-a and the dark soil patch, F10-l.

Knife scraper (n=1). Catno 1846 is an unusual tool. It has a long, sharp, slightly convex edge on one side opposed to a blunt, nearly straight edge of natural pebble cortex on the other (see Fig. 14.5). Both edges converge quite rapidly into a thin bifacially retouched point at one end, resembling

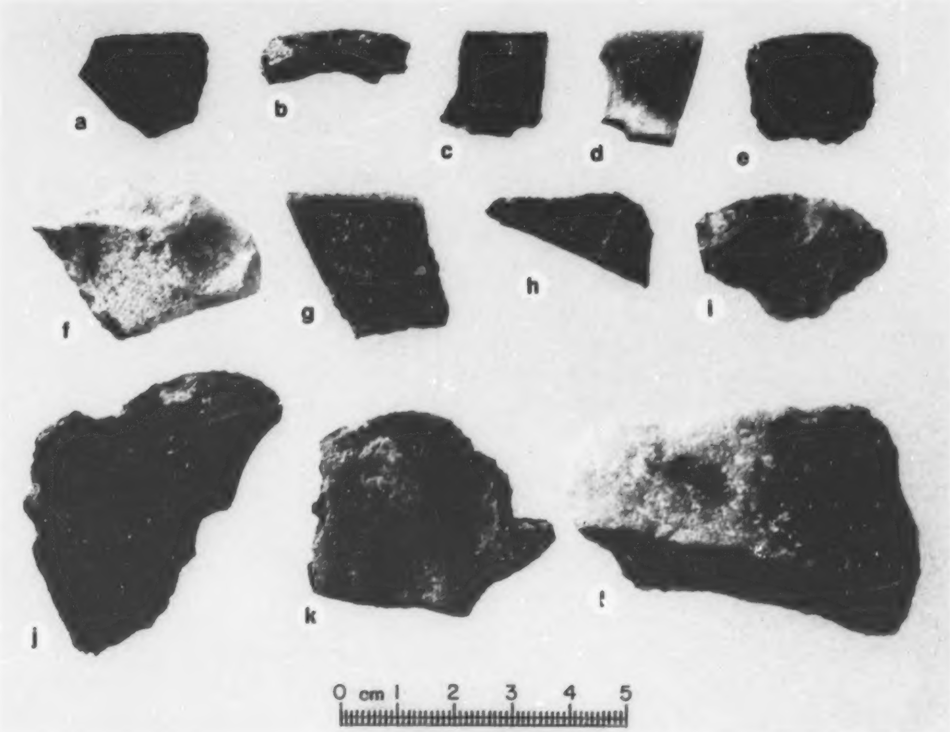


Figure 14.7. MURLs from Layer X.

in profile the tip of a modern butcher knife. Toward the other end is a transverse vertical fracture. By extrapolating the edges past the fracture one gets that impression that roughly the basal 40% of the original tool is missing. The most unusual characteristics of this tool are its retouching and wear patterns. The thin sharp edge is expertly retouched (dorsal face only) with flake scars extending about 5 mm back from the edge. This well-formed edge shows very little sign of wear although it would be highly suited for use as a cutting edge. Possibly it had been used as a cutting edge and had been newly resharpened at the time of discard. The tip of the same edge is bifacially retouched and shows slight signs of edge smoothing as might be expected from cutting. The other side of the same tip is also bifacially thinned, but has pronounced edge rounding and polish with a transverse orientation. The blunt continuation of that edge shows an even more marked transverse rounding and polish as might be expected from intense use in a scraping or planing motion. Moreover, the same blunt edge appears to have been crudely sharpened, by unifacial retouch on the ventral face. The contradiction in this tool is that a carefully formed edge shows the least sign of wear, while a natural edge has not only been intensively used, but also sharpened. This contradiction may be resolved if it is hypothesized that both edges were used, and that the tool broke either during an attempt to sharpen an edge, or in use just after the sharp edge had been retouched — hence, the name knife scraper.

MURLs (n=12). There are several kinds of modified edges among the MURLs (see Fig. 14.7). The simplest, represented by catnos 1853, 3539, 3586, 3962, 4285, and 4431, are 2-6 cm long flakes or pieces of shatter which show evidence of use wear (edge smoothing/polish or crushing, and occasional flake scars) along a naturally sharp edge segment at least 15 mm in length. Such edges are usually nearly straight in plan. Their probable use is for cutting soft substances, such as meat or hide. Catno 4431 is the largest example of this kind. Clinging to crevices and hollows of its crushed edge are microscopic traces of a granular substance resembling haemoglobin. Another kind of MURL is represented by a large piece of shatter (catno 4114) which has steep, mainly unifacial, retouch along a 20 mm segment of a moderately thick convex edge. It may have been used as an endscraper. Catno 3822 is a medium-size, slab-like, cortical flake with bifacial retouching along a 20 cm segment of convex edge. The edge looks fresh, but step fractures close to the edge on one side give it a dull feel. Whether this is merely an attempt at tool making or an actual cutting edge is not clear. More extensively retouched MURLs (catnos 3281, 3703 and 4291) make use of the lateral edges of thin flakes. In each case the flake is more than 25 mm in length and less than 5 mm in thickness, and a thin nearly straight cutting edge is defined by a continuous row of tiny unifacial flake scars along a distance of at least 20 mm. The edges vary from continuously fresh and sharp; to mainly fresh and sharp with occasional small, well rounded, projecting edge remnants that have escaped sharpening; to quite rounded and dull. Since these tools are delicate and their wear is restricted to a narrow zone on the edge, their likely function is for cutting thin soft substances such as hide or sinew. Catno 3385 is a variant of this type with a segment of similarly retouched and utilized edge on one side, and a distinct unifacially retouched point on an end at the opposite side. The side edge probably functioned as a fine cutting tool while the point could have been used as a perforator.

Perforators (n=3). Catno 3558 is the tip of a narrow, bifacially edged, pointed tool (see Fig. 14.8). Its edges converge at an angle of about 28° to a sharp but somewhat squared point measuring about 2 mm across. The lateral edges are lightly worn or polished, a characteristic which is more pronounced toward the pointed end. The tip has separated along a spiral hinge fracture with a diagonal orientation to the long axis of the tool. Such a fracture suggests failure due to both twisting and snapping forces, as might be expected for a drill tip. Catnos 4333 and 4343 are pieces of shatter each with a natural point on one end. In both cases the point has been enhanced by unifacially retouching the edges from about the midpoint to the tip. The edge on one side is thinner than the other and shows the greatest amount and extent of retouch. The angle formed by tip edges is 35° for catno 4343 and 50° for catno 4333. Tips and immediately adjoining edges of both tools are quite fresh and sharp, but there is a bit of crushing and polish, on the thinner edge especially, about one-fifth of the length back from the tip. Presumably the distance from one edge to the other at that spot was the widest dimension of the hole reamed by the tool. Moreover, the distance to the tip, varying from 10-13 mm, gives a means for estimating maximum thickness of the perforated substance, assuming that the hole penetrated completely. Ten to thirteen millimeters would be sufficient to penetrate most hides.

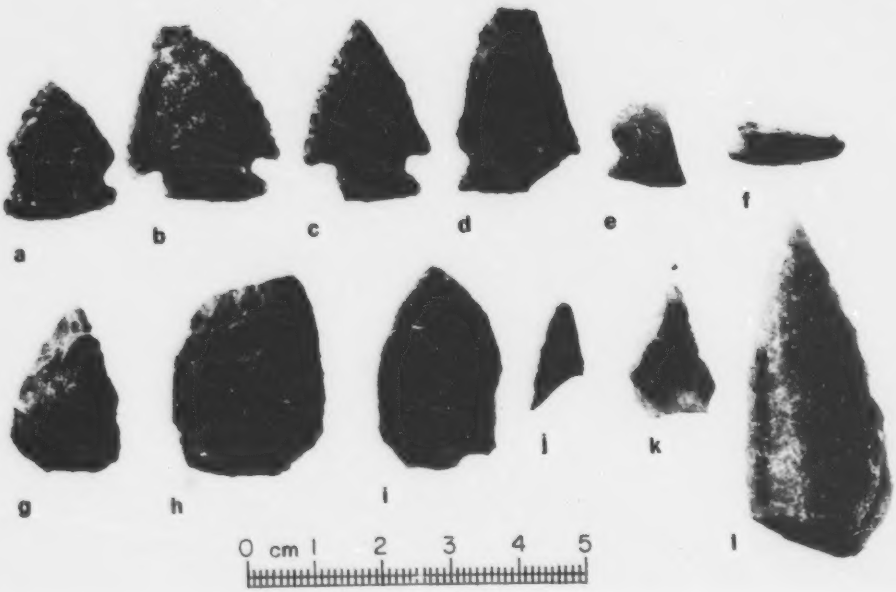


Figure 14.8. Projectile points (a-f), preforms (g-i), and perforators (j-l) from Layer X.

Projectile point preforms (n=3). Three items (catnos 3330, 3470 and 3906) have thin, roughly triangular shapes which are completely or almost completely formed by bifacial chipping (see Fig. 14.8). Lengths range from 25-30 mm. In two cases there is a point at one end opposed by a slightly convex base at the other, indicating that intended use was probably as projectile points. The third piece has the requisite base, but the tip has broken off. In all cases the sides tend to be gently convex in plan and straight to slightly sinuous in side view. Neither sides nor bases show wear or smoothing. Two pieces have serious chipping obstacles on the edges — an area of pebble cortex on one, and a ridge buttressed with step fractures on the other. Apparently the flintknapper(s) was unable to overcome these obstacles and simply discarded the pieces. The third item (catno 3906) is the smallest. Its perimeter has been completely chipped, but a central thickness remains in the haft area. It could only have been removed by making the piece much too small for use as a projectile point. Moreover, the base is not symmetrical and correction of that, too, would have required more reduction. Thus, the third item was probably also discarded as unfinishable. One notable thing about these preforms is the smallness of pieces of chipping material chosen for projectile point manufacture. The edge chipping on catnos 3330 and 3470, for example, left large portions of the faces untouched, showing that the original pieces of raw material have not been greatly reduced in size and demonstrating the ability of northern Plains flintknappers to produce well-formed projectile points from small pieces of stone.

Projectile points (n=6). One whole and five broken projectile points were found in Layer X (see Fig. 14.8). The breakage generally involves removal of the tip and a basal corner and, occasionally, a substantial part of the basal edge. In two cases fractures ran through one notch to just above the other leaving the base intact. All of the breakage appears to be the result of tip impact. The predominance of haft elements could mean that projectiles were being retrieved and brought back to camp for repair after being shot and damaged. Application of the Thomas (1978) discrimination equations for arrowheads and darts to four measurable specimens (catnos 1847, 1848, 3598 and 3670) yields values suggesting that three were arrowheads and one (catno 3670) was a dart point. From this we conclude that arrow and dart weaponry were in use at the same time, with arrows being slightly more common, at least with this group. A common stylistic element seems to have been a straight to slightly convex base. The notches, however, are of two types: (1) shallow side notches with the maximum width of the notch at least 25% greater than its maximum depth; and (2) moderately deep corner notches with notch width and depth approximately equal. The two types of notches did not appear together on any one specimen. Rather, a point is either side-notched or corner-notched. The side notches are set entirely on the side edge, sometimes almost touching the edge/basal juncture. However, they always have an orientation parallel to the base. The corner-notches originate on the side/basal junction, usually with a bias toward the side, and are oriented upward at an angle of about 30° from the base. Whether side-notched or corner-notched, the bases of all specimens seem to have been dulled by a combination of light crushing and abrasion. There is no evidence for areal or stratigraphic separation of the two types. For example, a corner-notched form (catno 3670) was found among the debris encompassing boiling feature F10-c, and a side-notched form (catno 1907) was found among the continuation of that debris toward and around hearth F10-a.

Comparisons: The side-notched points from Layer X easily fall within the range of forms known as Besant (Wettlaufer 1955; Reeves 1983a, 1983b; Ramsay 1991). The use of Knife River Flint and jasper, among other materials, certainly fits with the material preferences known for Besant. The corner-notched forms (catnos 1847 and 3670) fall within the type known in Saskatchewan as Pelican Lake (Wettlaufer 1955; Reeves 1983b). A similar corner-notched manifestation found in Manitoba is known as Larter Tanged (MacNeish 1958) or Larter/Pelican Lake (Buchner 1979). It is interesting to note that some of the "Besant" levels of the Mortlach site (Wettlaufer 1955) contained a mixture of Besant side-notched and Pelican Lake corner-notched projectile points with Besant having the edge in numbers, as in Layer X. A mixture with reversed proportions, corner-notched predominant, appeared in the substantial Larter/Pelican Lake component at the LM-8 site, Manitoba (Buchner 1979). Thus, the mixture of small numbers of corner-notched points with side-notched points (or vice versa) in northern Plains sites dating to about 2000-2500 B.P. is not uncommon.

Chipped Stone Debris

The dominant chipping material in Layer X (Table 14.4) is quartzite at 45.2% by weight. That value is somewhat skewed by the presence of one unusually large piece (479.5 grams). Other

Table 14.4. Chipped stone debris, excluding cores, from Layer X.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
agate	2	2	4	1	1	3	13
chert	13	8	10	3	2	29	65
chalcedony	1	1	3	-	1	-	6
Gronlid Siltstone	-	-	1	-	3	-	4
jasper	-	1	1	-	-	-	2
Knife River Flint	6	1	9	1	2	4	23
obsidian	-	-	-	-	1	-	1
petrified peat	29	63	142	17	18	59	328
petrified wood	-	1	4	3	5	3	16
quartzite	31	30	9	4	5	9	88
quartz	3	12	17	4	7	7	50
sandstone	-	-	-	1	-	-	1
silicified sediment	15	2	7	2	1	2	29
Swan River Chert	16	11	15	4	5	9	60
unidentified	-	-	2	-	-	-	2
Total	116	132	224	40	51	125	688
Weight							
agate	0.8	0.1	1.1	1.1	0.1	0.9	4.1
chert	17.3	18.0	24.9	2.5	4.8	54.5	122.0
chalcedony	0.4	0.4	1.3	-	0.6	-	2.7
Gronlid Siltstone	-	-	0.3	-	1.9	-	2.2
jasper	-	0.8	0.6	-	-	-	1.4
Knife River Flint	6.8	0.2	3.5	0.1	0.4	0.8	11.8
obsidian	-	-	-	-	1.3	-	1.3
petrified peat	73.8	137.9	148.3	24.5	55.0	87.1	526.6
petrified wood	-	0.6	1.0	7.7	11.5	2.8	23.6
quartzite	705.3	78.2	10.0	2.6	5.3	22.5	823.9
quartz	17.8	14.2	67.1	18.0	15.6	19.8	152.5
sandstone	-	-	-	7.0	-	-	7.0
silicified sediment	6.2	0.5	5.3	0.4	0.2	0.7	13.3
Swan River Chert	22.2	6.4	31.1	1.9	44.5	23.9	130.0
unidentified	-	-	0.3	-	-	-	0.3
Total	850.6	257.3	294.8	65.8	141.2	213.0	1,822.7

prominent materials are petrified peat (28.9%), quartz (8.4%), Swan River Chert (7.1%), and chert (6.7%). The use of quartzite and petrified peat indicates reliance on local river valley resources, while that of Swan River Chert and quartz may be an indication of commerce to the northeast. Exotic materials are quite varied and include traces of Knife River Flint from North Dakota, Gronlid Siltstone from north-central Saskatchewan and obsidian presumably from the Rocky Mountains to the southwest. The exotic materials are better represented among tools than by chipping debris. It is probable,

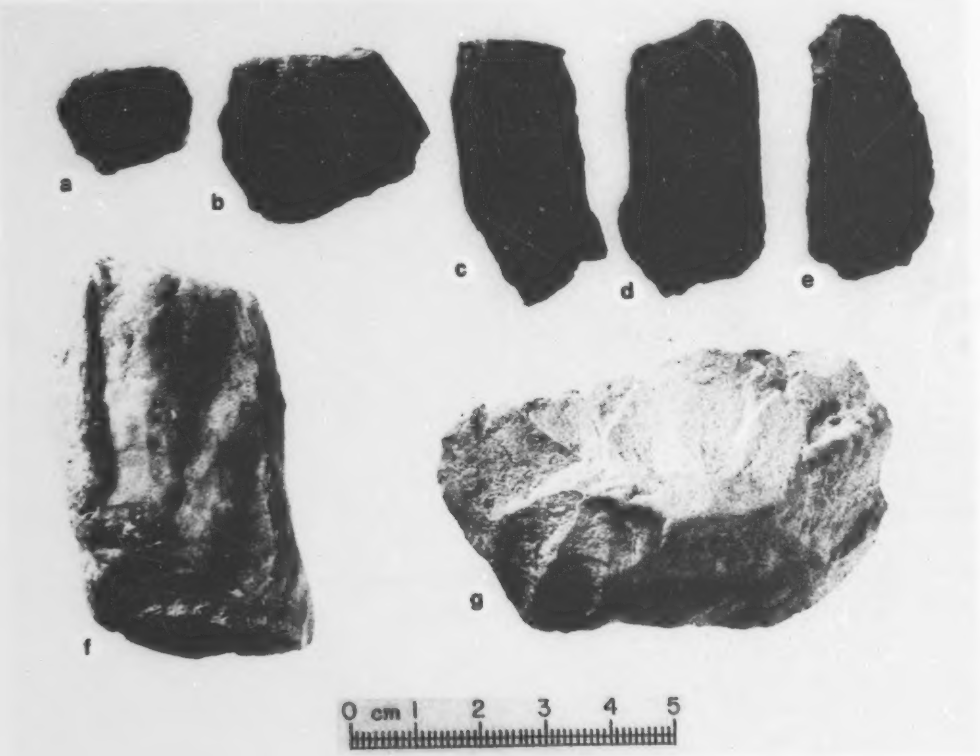


Figure 14.9. Chipped stone cores from Layer X.

therefore, that such materials entered the site mainly as tools.

As to the degree of reduction, quartzite, sandstone and quartz were generally rendered into pieces of large size (more than 3 g per specimen). Five materials, namely Swan River Chert, chert, petrified peat, petrified wood, and obsidian, are in the medium-size range (1.0-2.9 g). The seven remaining types are represented by small debris. Thus, a variety of chipping from core reduction totool sharpening was undertaken in Layer X with emphasis on middle and late chipping phases indicative of tool manufacture and repair.

There are seven chipped stone cores in Layer X (Fig. 14.9, Table 14.5). A limestone core is of the spall variety; all the rest are bipolar.

The distribution of flakes, shatter and cores reveals a general scatter throughout the excavated

Table 14.5. Chipped stone cores from Layer X.

Type	Catno	XU	Weight	Size*	Material	Fig.
bipolar	1849	1	15.0	b	silicified sediment	14.9d
bipolar	3485	1	16.1	b	petrified peat	14.9a
bipolar	3814	5	2.1	a	Knife River Flint	14.9c
bipolar	3881	6	8.6	b	silicified sediment	14.9e
bipolar	4011	3	9.6	b	petrified peat	14.9b
bipolar	4078	6	112.7	c	Swan River Chert	14.9f
spall	3382	2	86.9	c	limestone	14.9g

* size refers to categories based on greatest length: (a) 13-25mm, (b) 26-49 mm, (c) 50-100 mm, (d) 100-149 mm, and (e) 150 mm and larger.

area with concentrations in XUs 3 and 6 around hearth F10-a, and in XUs 1 and 2 near hearths F10-h and F10-e. Chipped stone tools had a similar distribution, but with a fairly strong showing of endscrapers and MURLs in XU 5. All tool materials are represented among the debris (items made of tuff and andesite have comparable debris among the coarse rock). However, quartzite, first among debris, is represented by only one tool. Other quartzite tools made here must have been carried away. On the other hand, Knife River Flint which represents less than 1% of debris is present in 18% of the tools. In that case, it appears that old tools were being discarded as they were used up.

Bone Tools

A bison right meatarsal from XU 1 (catno 3271) has been so heavily used as a hide grainer that the tool can be considered exhausted. The area of use began on the anterior face of the distal end which has become symmetrically beveled toward the posterior face until only the condyles remain (see Fig. 4.1).

Faunal Remains

A radiocarbon sample (S-1767) on bone from Layer X was drawn from Test Profiles Nos. 2 and 3, and it did not diminish the faunal assemblage discussed here (Table 14.6).

Bison, NISP=186: see Table 14.7. This is the first reasonably large assemblage of bison bones encountered in the Sjovold site, and it is undiminished by radiocarbon sampling. Both the tooth rows and the post-cranial elements represent a mix of calves and adults. The four tooth rows in Age Group C could all have come from a single calf about 2.0-2.6 years old, and the mandible in age group B is probably one year younger. The maximum possible post-cranial MAU is 2.0 based on the humerus. Similarly, adult tooth rows represent 1.5 animal units, in agreement with the post-cranial data.

Table 14.6. Vertebrate remains from Layer X.

Size, Taxon	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
6, Bison	39	73	33	12	20	9	186
5-6, mammal	87	82	42	118	26	11	366
5, Deer or Pronghorn	-	-	-	1	1	-	2
5, Pronghorn	1	-	-	2	-	-	3
5, Wolf	-	6	13	-	1	4	24
4-5, Carnivore	-	-	-	-	1	-	1
4-5, mammal	1	-	1	-	1	-	3
3, mammal	1	2	1	-	1	-	5
2, Pocket gopher	-	1	-	1	-	-	2
1, Least chipmunk	-	-	-	-	-	1	1
1, Red-backed vole	-	1	-	-	-	-	1
-, mammal	745	1,535	649	250	241	173	3,593
Total	874	1,700	739	384	292	198	4,187
Weight							
6, Bison	1,512.7	2,491.6	1,898.0	318.2	891.0	190.2	7,301.7
5-6, mammal	401.3	380.5	239.4	201.9	101.4	50.3	1,374.8
5, Deer or Pronghorn	-	-	-	10.8	21.3	-	32.1
5, Pronghorn	18.3	-	-	34.3	-	-	52.6
5, Wolf	-	76.1	98.6	-	60.6	68.3	303.6
4-5, Carnivore	-	-	-	-	0.1	-	0.1
4-5, mammal	2.2	-	1.3	-	0.9	-	4.4
3, mammal	0.1	2.2	0.3	-	0.2	-	2.8
2, Pocket gopher	-	0.2	-	0.2	-	-	0.4
1, Least chipmunk	-	-	-	-	-	0.1	0.1
1, Red-backed vole	-	0.1	-	-	-	-	0.1
-, mammal	407.2	536.6	385.2	162.3	132.8	397.0	2,021.1
Total	2,341.8	3,487.3	2,622.8	727.7	1,208.3	705.9	11,093.8

Ten shaft fragments exhibit well preserved impact scars that result from fracturing for marrow retrieval, but it is remarkable that dry-state fractures are as common as fresh-state fractures among the identifiable bison bones (Table 14.8). This proportion is consistent with relatively advanced weathering; 41 bones are weathered to Stage 1 and 11 to Stage 2. Two bison bones exhibit cut marks. A single incision on the lateral surface of a coronoid process probably resulted from efforts to disarticulate the mandible from the skull. Multiple incisions on an ischium are probably related to filleting. A femur shaft fragment is charred, and a 2nd phalanx is calcined. It is surprising that so few bones show evidence of burning, because 55 specimens were found in hearth fill. Either during or after the human occupation, carnivores gnawed on eight of the bison bones. Their tooth marks are located in the usual blood-rich, thin-walled areas such as the end of a rib, the edges of three ilium

Table 14.7. Bison elements and fragments from Layer X.

Element	NISP	MNE	Calf	Cow or Calf	Cow	Bull
Horn core	1	1	-	-	-	1
Tympanic bulla	3	3	-	-	-	-
Maxilla[a]	18	6	-	-	-	-
Mandible[b]	18	6	-	-	-	-
Atlas	1	1	-	-	-	-
Thoracic vertebra	1	1	-	-	-	-
Rib	25	25	-	-	-	-
Scapula	4	3	1	-	-	-
Humerus	12	6	3	1	-	-
Radius	7	4	-	1	1	2
Ulna	5	2	-	-	-	-
Radial carpal	2	2	-	-	-	1
Intermediate carpal	4	4	-	-	-	3
Ulnar carpal	3	3	-	1	-	1
Carpal 2+3	1	1	-	-	-	1
Carpal 4	2	2	-	1	-	1
Accessory carpal	3	3	-	-	-	-
Metacarpal III+IV	6	3	-	-	-	1
Metacarpal V	1	1	-	-	-	-
Front 2nd phalanx	1	1	-	-	-	-
Innominate	8	3	-	-	-	-
Femur	6	3	-	-	-	-
Tibia	13	5	-	1	-	1
Lateral malleolus	2	2	-	1	-	1
Talus	3	3	-	1	-	2
Calcaneus	4	4	1	-	1	2
Tarsal C+4	3	3	-	1	-	2
Tarsal 2+3	4	4	-	1	-	2
Tarsal 1	2	2	-	-	-	-
Metatarsal III+IV	10	4	-	1	2	1
Hind 1st phalanx	6	6	-	1	-	5
Hind 2nd phalanx	1	1	-	-	-	-
3rd phalanx	3	3	-	-	-	-
Prox medial sesamoid	1	1	-	-	-	-
Prox lateral sesamoid	1	1	-	-	-	-

a. 2 maxillae in age group C, 2 in age group 6. b. 1 mandible in age group B, 2 in age group C, 1 in age group 10.

fragments, two distal humeri, a juvenile humerus shaft, and a distal radioulna. After burial, the Layer X bison bones apparently had a long residence time in the active layer, because all but 20 of them have been etched by rootlets, with 34 having reached a moderate degree of etching.

Table 14.8. Modified vertebrate remains from Layer X.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	2	2	8	-	52	166	22	3	60	65	36	186
5-6, mammal	-	96	1	-	*	*	164	16	34	152	-	366
5, Deer or Pronghorn	-	-	-	-	1	1	-	-	-	2	-	2
5, Pronghorn	-	-	-	-	1	3	-	-	-	3	-	3
5, Wolf	-	-	2	-	8	20	1	2	9	3	9	24
4-5, Carnivore	-	-	-	-	-	-	1	-	-	-	-	1
4-5, mammal	-	-	-	-	-	3	-	-	2	1	-	3
3, mammal	-	-	1	3	-	2	-	-	2	3	-	5
2, Pocket gopher	-	-	-	-	-	2	-	-	-	1	1	2
1, Least chipmunk	-	-	-	-	-	1	-	-	-	1	-	1
1, Red-backed vole	-	-	-	-	-	1	-	-	-	-	1	1
-, mammal	1	851	1	4	*	*	-	*	*	*	-	3,593

[a] TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

Size 5-6 mammal, unidentified, n=366: 24 cranial, 164 tooth, 36 rib, one scapula, 141 long bone shaft fragments. Of 96 burned specimens (41 charred, 55 calcined), nearly all were associated with a surface hearth, feature F10-k, in XU 4. One long bone fragment bears a carnivore tooth mark.

Deer or Pronghorn, NISP=2: distal humerus, radius shaft fragment. The radius is weathered to Stage 2.

Pronghorn, NISP=3: distal humerus, radius shaft, metatarsal shaft.

Wolf, NISP=24: M_1 crown, atlas*, axis*, three complete lumbar vertebrae, three lumbar fragments, rib, distal scapula*, distal humerus*, humerus shaft, distal radius, radius*, proximal ulna*, two ulna shafts, tibia*, metatarsals III* and IV, two 2nd phalanges, phalanx fragment. Specimens marked with an asterisk (*) furnished measurements in support of the species identification. In all cases these bones are larger than our larger reference dog, and in many cases they are larger than our smaller reference wolf (see Fig. 5.3). All of the bones could be derived from a single skeleton. The three fresh-fractured bones are the two humeri and a radius. The molar crown was found in hearth F10-a. The distal humerus and the proximal end of the tibia have been furrowed by a carnivore.

Size 4-5 carnivore, unidentified, n=1: molar fragment.

Size 4-5 mammal, unidentified, n=3: two ribs, one long bone shaft fragment. From their size and association with other elements, it is likely that these pieces are from the wolf.

Size 3 mammal, unidentified, n=5: vertebral centrum, rib, 3 long bone shaft fragments. The vertebral centrum is tooth-punctured and locally coated with fecal material, and two long bone fragments are pitted and thinned by digestion.

Northern Pocket Gopher, NISP=2: proximal femur, tibia missing its proximal epiphysis. The femur was fractured when fresh.

Least Chipmunk, NISP=1: mandible containing I_1-M_3.

Gapper's Red-backed Vole, NISP=1: mandible with all alveoli, containing I_1-M_2.

Unidentified mammal, n=3590: fragments, of which all but 55 are less than 4 cm in length and the remainder range from 4 cm to 12 cm long. Most of the burned fragments (681 charred, 170 calcined) were associated with surface hearths, features F10-e and F10-g, in XU 2. One fragment is tooth-marked, and two have been digested. One, from XU 1, exhibits a single cut mark.

Snails: Sixteen small gastropods, a few from each XU, were recovered from Layer X.

Plant remains: Charcoal was collected from three hearth features in Layer X, and two of the samples were sacrificed for radiocarbon dates. A sample (4.5 g) from F10-e in XU 2 consisted primarily of *Prunus* sp. charcoal and was used to obtain the date of 2340 ± 120 B.P. (S-3367). Charcoal (4.1 g) from F10-k in XU 4 included either *Prunus* sp. or *Acer negundo* wood as well as *Salix* sp. twigs, and it produced a date of 2190 ± 140 B.P. (S-3366). The third sample (1.5 g) from F10-i in XU 1 has been neither dated nor identified. (We are grateful to R.J. Mott, Terrain Sciences Division, Geological Survey of Canada, for the charcoal identifications from the Sjovold site).

Discussion: Portions of at least five artiodactyls — bison bull, cow, two calves, and a pronghorn — are present in Layer X. These animals formed the main subsistence base, and the bison calves indicate a late spring or summer season for the occupation. Filleting and impact marks show that both meat and marrow were procured from these carcasses.

Some aspects of the bone modification data seem peculiar and difficult to explain. The close association of many bison bones with hearth fill has not resulted in a high frequency of charring and calcining, whereas smaller fragments of unidentified mammal bone commonly show evidence of burning. Burning may help to reduce fragment size and render the bones unidentifiable, but this idea does not help to explain why so many unburned bones were recovered from hearth fill. We believe that one function of the boiling pits may have been bone grease manufacture. Once the grease was rendered and skimmed off, the still-greasy bone fragments would have been removed from the hide container, and they may have been thrown into a hearth as an expedient means of disposal as well as a fuel supplement. The larger unburned bones might later be thrown into the extinguished hearths during clean-up of a separate nearby activity area.

Another peculiarity is the low frequency of digested bone among elements conspicuously marked by carnivore teeth. Carnivores expel digested bone both in vomit and in scat, and a review of other layers of the Sjovold site shows that digested bone is often more abundant than tooth-marked bone. Perhaps these variations reflect the timing of carnivore gnawing in relation to the presence of people on the site. Human presence might inhibit a carnivore from expelling bone in an encampment.

The wolf remains have been scavenged by a carnivore. There are no cut marks on the bones, and very few of them were fractured when fresh. They are especially abundant in XU 3, but only one element was found in the hearth located there. Perhaps a wolf was procured for its skin and its carcass fed to dogs.

The significance of the smaller mammals — pocket gopher, chipmunk and vole — is not clear, but they appear to be coeval with the larger taxa since all of their bones have been etched by rootlets.

Interpretation of Layer X

Interpretation of Layer X is hampered by our suspicion that more than one episode of occupation may be represented. There is one cluster of features, a row of alternating hearths and boiling rings (hearth F10-a stone ring F10-c, hearth F10-e, stone ring F10-f, and hearth F10-i) which we think were very likely contemporaneous. We found matching bison tooth rows with features F10-e and F10-i which tie the middle and east end of the row into one phase of activity. It does not seem a great interpretive leap to include the rest of the row. There is one feature touching this group, hearth F10-g, which we suspect may have belonged to a different phase of occupation. Its close proximity seems to impinge upon stone ring F10-f. Moreover, there were two other hearths nearby at appropriate spacing to serve that ring. The balance of the features (F10-d, F10-h, F10-k and F10-l) are of ambiguous temporal position. All were close in time (presumably days to months) to the main feature group. It is even possible that they, too, were contemporary. If there was more than one phase of occupation in Layer X, then almost all individual artifacts are open to question. To which phase did each belong? However, multiple occupations have not been established beyond doubt, and it is our impression that, even if there were more than one phase, the boiling ring and hearth row would have by far the strongest expression. Since we have not discovered a satisfactory way to resolve the question about single or multiple phases of occupation, we will arbitrarily interpret the artifacts and features, except for F10-g, as if they belong to a single occupation.

Our general impression is that the exposed area of Layer X was devoted primarily to two (and probably more) hearth and boiling vessel operations. A number of activities — animal processing, consumption, and chipped stone tool manufacture or repair — were carried out around these features. The actual process of heating stones in close proximity (60 cm) to a boiling basin is quite clearly indicated by these remains. Space would allow for anywhere from one to about five people to be seated around each hearth and boiling basin. Although the boiling operations appear to have been similar in many respects, there were some differences, principally in the distribution of associated debris. For the western group the surface immediately surrounding hearth F10-a and the nearby F10-c ring revealed a fairly dense scatter of chipped stone and broken bone. The hearth itself bore similar but less dense debris. The eastern group was opposite with a greater density of debris in the hearth (either F10-e or F10-i) than on the surrounding surface. Perhaps the second group of occupants were sitting on hides or mats and shook them clean over the fire before they left.

It is evident that there was crowding among the Layer X features. Perhaps the positioning of boiling operations was influenced by the same ridged landform as exists today. People would have had only a small amount of ridge top on which to sit, especially if they wanted to be near the creek. Another reason for crowding might be that the features were within a dwelling. They were too closely grouped for there to have been two dwellings side by side. The use of wood (as opposed to bison dung) for fuel might be taken as an argument in favour of this idea, but it seems a weak argument when there is no other supporting evidence for a large dwelling. Another possibility is that dwellings, if any were present, were sited farther north on the ridge, well back from the creek bank. In that case the boiling operations would have been outside near the creek. In this connection it is interesting to note the linear arrangement of the main two hearth-boiling basin groups. They lay in an almost straight line parallel to and about 2.5 m back from the present creek bank. This suggests that their positioning was related to the bank. Further, one wonders if the creek bed was the source of the rocks so liberally used both for heating and for basin formation. It might have been ready availability of rocks, rather than cold weather or lack of a digging implement, which prompted their use for boiling basin construction. In any case, outdoor operation of the boiling pits is our preferred interpretation. It carries an implication that the site was occupied during fair weather, at least during use of the F10-c and F10-f boiling operations.

Animal bones in and around the features represent parts of as many as four bison, one pronghorn, and a wolf, probably accounting for the main subsistence in this camp. Filleting and impact marks on the bones show that meat and marrow were being procured from the carcasses. The presence of bison calves is evidence for a late spring or early summer occupation. Selection for bull limb elements is consistent with spring occupation since cows would not have recovered from calving and nursing which can leave them in poor condition. Most of the tools were probably used in the procurement and processing of these animals: the damaged projectile points in hunting; the biface in dismembering; the endscrapers in cleaning and thinning hides; the perforators for making holes in hides; and so forth. The features seem to reflect consumption of these animals by boiling, marrow extraction, and perhaps bone grease manufacture, and they served as a focus for fireside activities such as repair or replacement of stone tools, hide working, and perhaps the cutting of sinew for rehafting of projectile points.

Other local resources exploited by Layer X inhabitants include petrified peat and quartzite for manufacture of stone tools. These materials dominate the chipped stone detritus and indicate that the occupants both knew the locality well enough to find these materials and had the time and surface visibility (no snow) to do so. Granite from creek or river beds or from nearby valley slopes was used for stone boiling and for making the boiling basins. Other stone chipping materials which could be found in the general region (quartz, chert and Swan River Chert) were found in fair quantities indicating that occupants knew both local and general areas. A surprising variety of exotic stone types, Gronlid Siltstone, Knife River Flint, obsidian, and possibly the yellow jasper, indicate either commerce toward several distant sources or proclivity for recycling exotic materials found among other people's debris.

An estimate of the number of people present is clouded by the question of multiple occupations. If all the debris belonged to just one occupation, then it could have been laid down by a party of 12-15 people over a period of a few days or a week. More phases would mean less people per visit and/or briefer visits. The question of group composition is subject to the same foibles. If all the tools resulted from one visit, then it might be argued that the strong presence of projectile points and endscrapers means that both men and women were present. We have already raised a suspicion about this equation because of the poor workmanship on the endscrapers. An alternative explanation might be that it was an all male party in which men or boys were making and using endscrapers in order to get some use out of fresh hides. The need for hides might have been immediate as, for example, to manufacture canoe coverings or rope. Alternatively, the need may have been longer term, as interim preparation, for example, preliminary to transportation and finishing in a base camp elsewhere. The cultural identity of the group or groups, based on projectile point styles, would seem to be mainly Besant with a touch of Pelican Lake or Larter Tanged. We do not think that the mixture of types is necessarily indicative of multiple occupations. Both types seem to have been present in one group of features. A radiocarbon date on bone correlated to Layer X from nearby deep profiles yielded an age assessment of 2090 ± 165 B.P. Charcoal from hearth F10-e at the middle of the row of hearths and boiling rings yielded an age of 2340 ± 120 years B.P. Another sample of charcoal from hearth F10-k yielded an age of 2190 ± 140 years B.P. These dates can be averaged for an age estimate of 350-150 BC (cal 2300-2100 BP; Table 3.6).

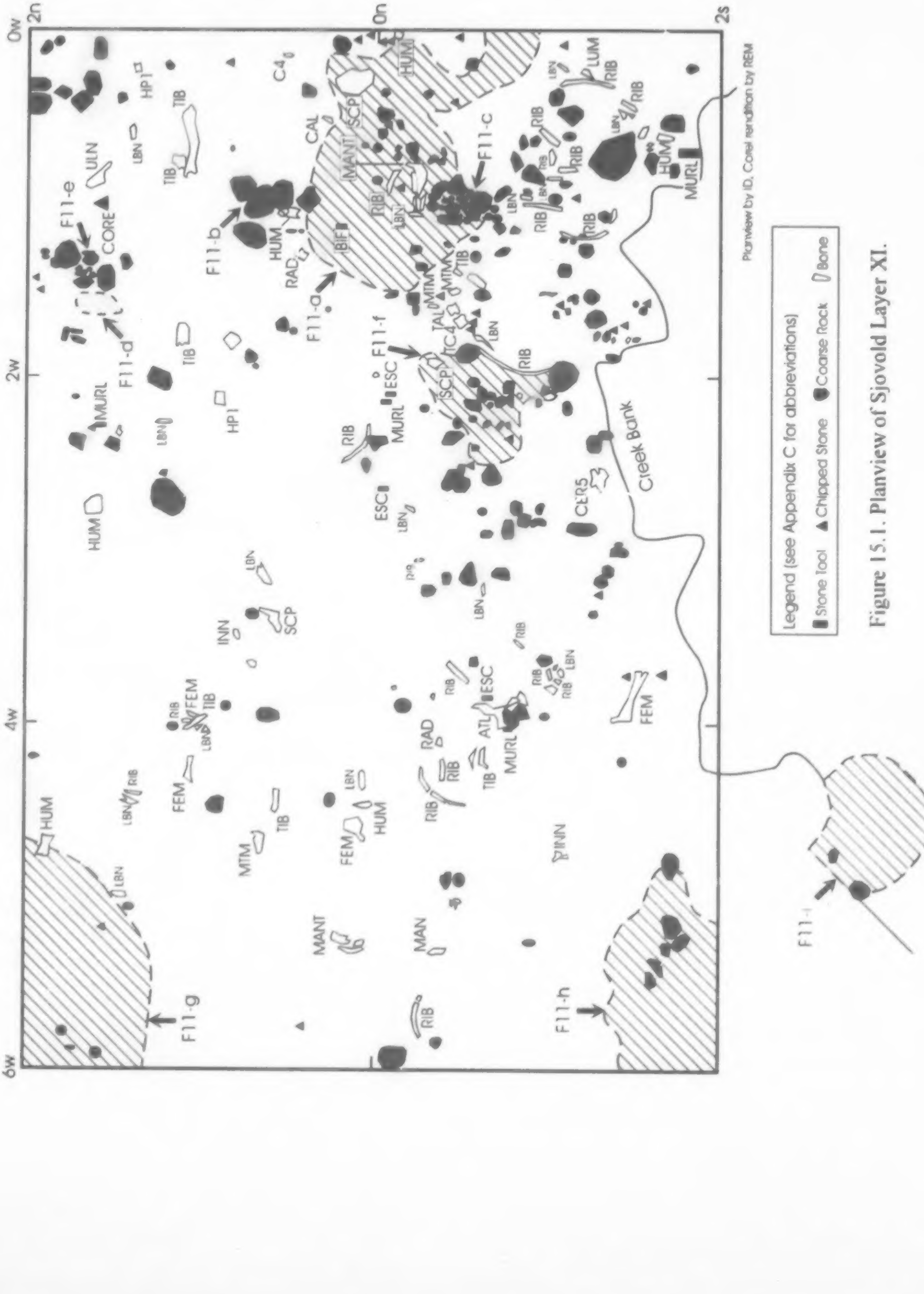

0w
2w
4w
6w
2n
0n
2s
F11-a
F11-b
F11-c
F11-d
F11-e
F11-f
F11-g
F11-h
F11-i
CORE
ULN
HP1
TIB
LBN
MURL
HUM
C4
CAL
MANT
SCP
BIF
RAD
ESC
RIB
MTM
TAL
TC4
LUM
CER5
FEM
INN
ATL
MAN
Creek Bank
Legend (see Appendix C for abbreviations)
Stone Tool
Chipped Stone
Coarse Rock
Bone
Planview by I.D. Corel rendition by REM

Figure 15.1. Planview of Sjovold Layer XI.

Chapter 15

Layer XI: Bratton Points in an Outdoor Workstation

Introduction and Planview

Layer XI lies 169-178 cm BS at 2n2w. For the most part, the occupation matrix could not be distinguished from enclosing deposits except by cultural materials. There were, however, places where a very faint grey soil colour was combined with cultural evidence marking the layer for distances of a meter or more. Layer XI was the second case in which we exposed a 23 square meter area at one time. Exposure revealed nine features and a substantial amount of occupation debris including distinctive convex-based projectile points which we have given the type name, Bratton. Most occupation remains were in the top two-thirds of the layer. Layer XI sloped downward to the west and southwest from a high point at 2n2w at a rate of about 1:26. To the east and southeast the slope was much gentler. Disturbance included an infilled animal burrow, horizontal and about 8 cm in diameter, which penetrated the south side of hearth feature F11-f from the southeast in XUs 4 and 5. Two radiocarbon age assessments on Layer XI yielded contradictory results. We accept the date which falls between estimates for layers immediately above and below and reject the other. This yields an age for Layer XI in the range of 550-250 BC (cal 2500-2200 BP; Table 3.6). Interlayer XI/XII ranges from 2-7 cm in thickness and consists of buff-coloured sandy silts. We excavated it in two levels and later merged materials from the top portion, our excavation level 11-4, with the materials of Layer XI, while those from the bottom, level 12-1, were merged with Layer XII.

The planview (Figs. 15.1-15.2) reveals the locations of all nine features and many of the coarse rocks, stone tools, and identified bones recovered from this layer. In the following descriptions we make reference to many items shown on the planview as well as to many items recovered by screening and not precisely piece-plotted. The associations with features among the screen recoveries is known through our having screened each feature vicinity separately.

Features

Feature F11-a (Fig. 15.1, Table 15.1), a surface hearth near the east edge of excavations, was at the center of a complex grouping of occupation debris. In planview the hearth had an unusual outline. The central body was a roughly circular area about one meter in diameter. To this was attached an eastern extension which meandered southeast beyond the limit of excavation. The central body had a fair amount of broken bone, chipped stone and small pieces of fired rock scattered over its surface, particularly on the south half. There was a well made quartzite biface on the northwest

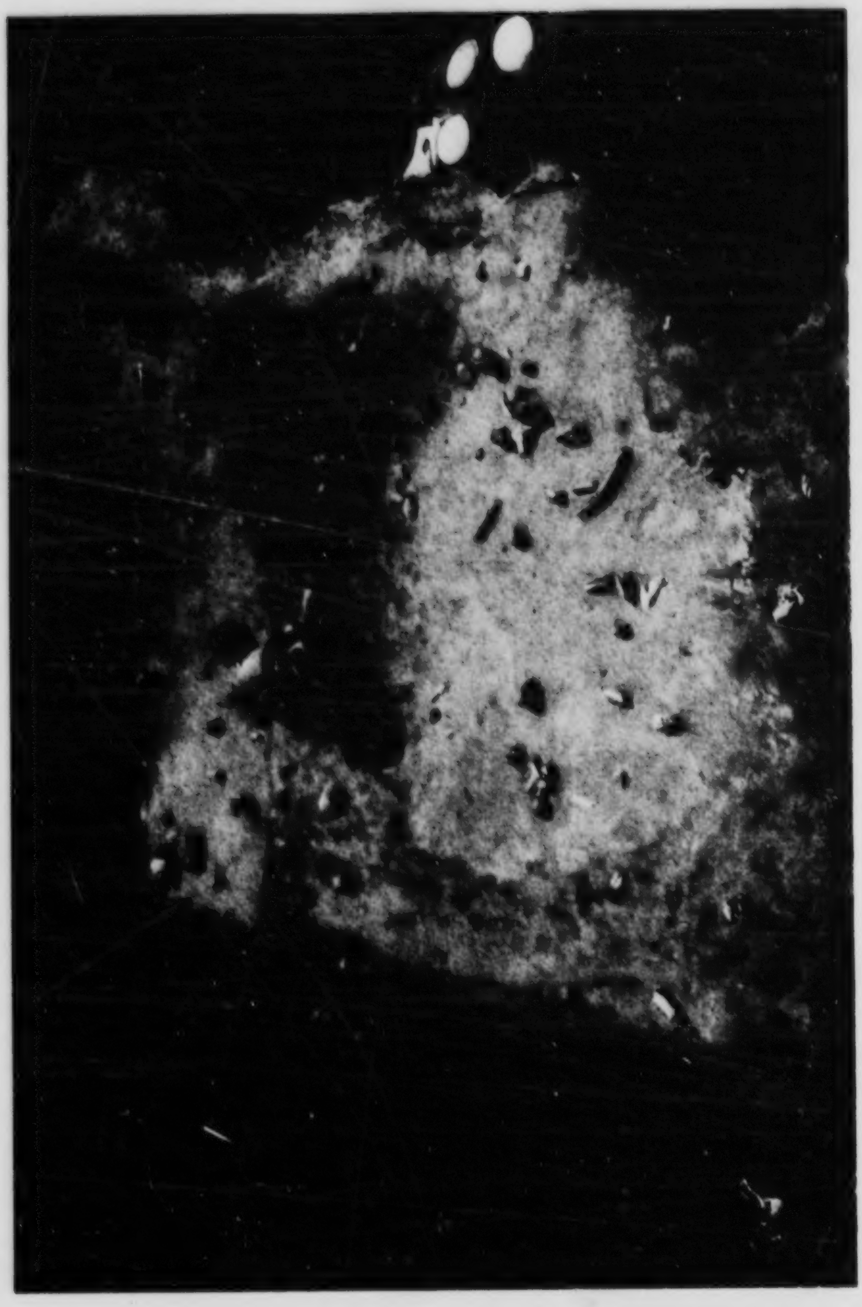


Figure 15.2. View from the west of occupation debris in Layer XI. RSM #EiNs-4:80-180 CT.

Table 15.1. Features in Layer XI.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F11-a	surface hearth	0s85w	130	150	0-11
F11-b	rock cluster	57n105w	41	38	0-13
F11-c	rock cluster	50s100w	52	38	0-10
F11-d	comminuted bone cluster	157n158w	25	11	1
F11-e	rock cluster	171n137w	53	29	0-9
F11-f	surface hearth	65s217w	92	70	0-6
F11-g	surface hearth	220n540w	>60	>125	2-11
F11-h	surface hearth	170s550w	>80	>120	3-19
F11-i	surface hearth	300s460w	>65	>80	0-11

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

quarter. Touching the north-central edge was a cluster of five large stones (F11-b). Straddling the south-central edge was a cluster of smaller but more numerous fired rocks and fragments (F11-c). South of that, and roughly centered on the hearth, was a fairly dense surface concentration of rock, bone fragments and chipping debris extending to the creek bank. Another hearth, F11-f, was situated 45 cm southwest of F11-a, but at a slightly lower (3 cm) elevation. The F11-a hearth was easily distinguished by its grey-black matrix including small chunks of charcoal. The surrounding occupation surface was buff-grey. In section we could see that the central part was underlain by a flattened lens of similar grey-black matrix and debris. Maximum depth of the lens was about 9 cm. The eastern extension also had an underlying grey-black lens composed of soil, combustion residues and occupation debris, but it was a little thinner, perhaps 5 cm in greatest depth. The combined subsurface lenses contained 226 rock fragments weighing 5,146 g, 41 pieces of chipped stone weighing 58.1 g, a MURL (catno 5232), and about 85% of the charred and calcined bone fragments in Layer 11 (n=771).

The charcoal in F11-a indicates that at least some of the fuel was wood, probably Manitoba maple (R.J. Mott, pers. comm. in 1990). The mixture of debris and combustion materials, both surface and subsurface, shows that the hearth was a minor disposal area whose contents were churned during the life of the hearth. Presumably, much of the disturbance was due to cycles of rock placement, burial in coals, and retrieval for stone boiling. The cause of the irregular eastern extension is not clear except that it seemed to provide a less intense version of the heating, churning and disposal seen in the main part. Additional information about F11-a comes from associated features and surrounding debris.

Feature F11-b consisted of five large pebbles and cobble fragments weighing about 6,300 g. All were firm, but exhibited the surface spalling and/or angular fractures which signal exposure to intense fire. Four were arranged in a slightly zig-zag line extending north from F11-a. The fifth was about 20 cm west of that line and created a little alcove with an open end facing the hearth. On the surface of that alcove were several fragments of uncharred bone. The soil beneath the bones was grey and appeared to be heavily infused with ash. Our guess is that F11-b represents a drying and warming station where rocks which had been used as boiling stones were prepared for another heating in F11-a. They may also have served as a platform upon which bones were roasted or broken. Possibly related features are F11-d and F11-e, situated on the opposite side of a 50 cm void north of F11-b. Before describing them, however, we will consider a feature which matches F11-b.

Feature F11-c was a tight cluster of fired rock, about 50 cm in diameter, on the south edge of hearth F11-a. It contained at least 24 pieces weighing about 5,200 g. There was little else within the cluster (one bone fragment and one piece of chipped stone), but a scatter of bone, chipped stone and fired rock lay on the hearth immediately to the north. There was an even more extensive scatter of materials southward to the creek bank. Our suspicion is that F11-c can be explained by one of two interpretations: (1) as the remains of a charge of heated rock that had been dragged from the coals of F11-a to be kept hot and picked over for use as needed; or (2) as a discard area where undesired hearth materials were pushed. The tight clustering and general lack of mixing with non-rock materials supports the first explanation but raises the question of why rocks would be warmed on two sides of the same fire. Possible answers are that there may have been more than one person working at fireside or that shifting winds could have induced a person to move from one side to the other to escape the smoke. However, the amount of debris in potential sitting areas to the south of the cluster, especially to the southeast, would have made sitting uncomfortable. A possible exception might have been a small area to the southwest where occupation debris was less concentrated. We were able to refit a piece of cream/orange/grey granite (catno 4883) from F11-c with a piece of the same material (catno 4977) found about 70 cm to the southwest of F11-c. One supposes that it is possible that the fire was used from the south side during initial stages and from the north later. Moreover, when the north side was in use the south side might have become a toss zone where additional garbage was discarded. One thing that is clear is that the fireside (sitting) area on the north side of F11-a was much less congested with debris than was the south side.

Feature F11-d was one of two features situated a little more than a meter north-northwest of F11-a. It consisted of a small tightly clustered patch of finely broken bone fragments. The cluster was about 25x11x1 cm. Bone fragments were intermixed with and enclosed in buff-coloured sandy silt like that of the adjoining occupation surface. The fragments lay in a jumble, some side by side, some criss-crossed. Many had been broken further within the cluster as shown by the articulated arrangement of some fragments. The concentration contained 264 fragments, 15 of them charred, the total weighing only 19.3 g. This feature was very close to a cluster of rocks, F11-e, only 5 cm to the west (see Fig. 15.3). However, its elevation was nearer the top of F11-e than its base. The amount of bone and the size of F11-d seem too large to be the remains of an animal scat, and none of the bones shows evidence of digestion. Rather, we suspect that they are the residue of a small bone-boiling operation, perhaps for bone grease manufacture.

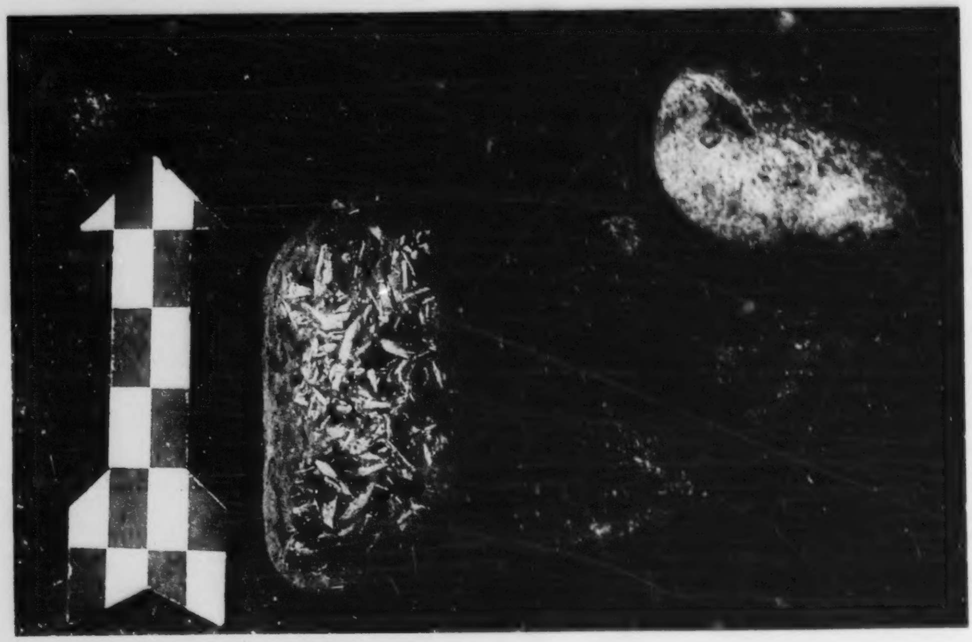


Figure 15.3. Close-up of finely broken bones (F11-d) and rock cluster (F11-e). RSM #EiNs-4:80-161 CT.

Feature F11-e was a tight cluster of rocks consisting of eleven angular granite and gneiss fragments weighing about 2,200 g, and a central dolomite cobble weighing about 3,100 g. The fragments show signs of firing — advanced disaggregation of surfaces and blocky shapes with angular fractures. The cobble surface is natural and smooth except for the upward facing apex that has been scarred by impact with a hard object. The detritus of impact, at least that from the cobble, was not among fragments in the feature. The cobble and surrounding fragments seemed to be at the same base level, about 3-5 cm below the base of F11-d. The top of the central cobble was about 2 cm higher than the top of F11-d. There was one large chipped stone flake on the northwest periphery at the same base level as the rocks, but additional fragments of rock, chipped stone and bone were sparse for about 50 cm in all directions (the limit of excavation was just north of F11-e). Our speculation is that F11-e was a collection of rocks used for boiling or stewing and possibly, in the case of the dolomite cobble, as an anvil for rock breaking. The reason for breaking rocks might have been to reduce the mass for entry into a small container. The large cobble might also have been the anvil upon which the bones of F11-d were broken.

Feature F11-f was a small surface hearth about 45 cm southwest of hearth F11-a. It had six large well fired rocks on its peripheries and at least 13 smaller fragments at the center. The soil matrix

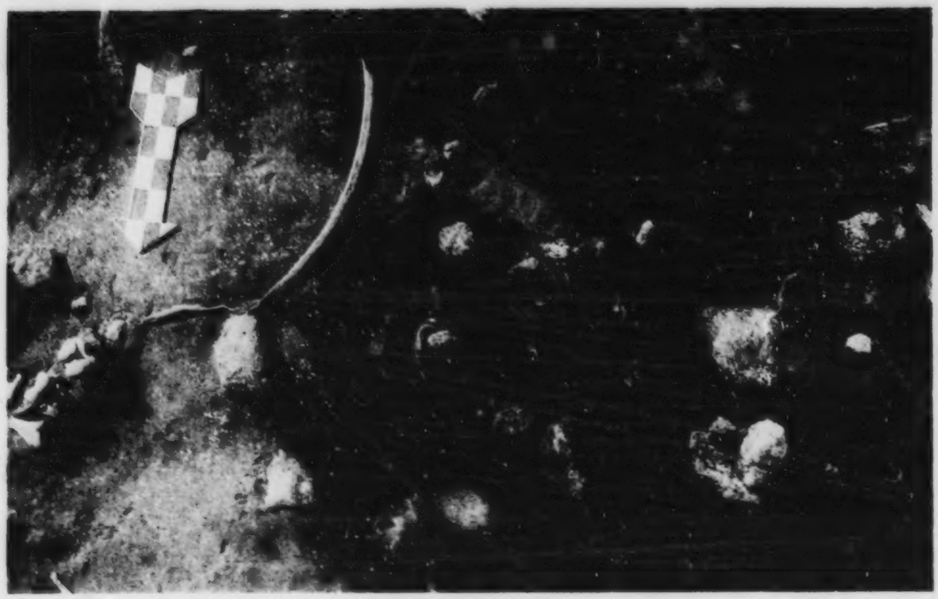


Figure 15.4. Hearth F11-f viewed from the north. RSM #EiNs-4:80-174 CT.

was very black with some patchy grey-brown and grey-white areas (see Fig. 15.4). We presume that the blackness was due to carbon residues (chunks of charcoal were not recovered) and the greyness to ash. A large fragment of a bison rib lay on the east margin. There was also one large bison scapula fragment on the northeast corner. Several other bones nearby in the space between hearths F11-f and F11-a comprise a partial left ankle assembly of a bison cow or calf. We found several pieces of chipping debris on the western edge of the hearth and a few more inside (totalling 9 pieces and 8.9 g). The surface layer, excluding the rocks, was about 2 cm in thickness. Underlying was a lens of burnt earth, approximately 4 cm thick, grey-black fire residues, and about 40 small pieces of fired rock fragments weighing some 550 g. Altogether, surface and subsurface rock amounted to 65 pieces weighing 2,188 g. A moderate scatter of chipping debris, bone fragments and stone tools lay on the surface up to a meter west of F11-f. The tools include four endscrapers and two MURLs. Immediately southeast was a small void in debris, perhaps 50x60 cm, already mentioned as a possible sitting place. Surrounding that was a denser scatter that merged with debris south of F11-a and included a broken biface, two endscrapers, three MURLs and a projectile point. Our records show that the surface of Fll-f was at least 3 cm lower than that of F11-a only 45 cm to the east. However, we believe that the difference can be accounted for by the natural slope of the occupation surface.

F11-f seems to have been a place where rocks were warmed or kept warm, and near which meat and bones were processed and perhaps consumed. Stone chipping was also undertaken in this vicinity. It seems likely that a woman occupied the west side of F11-f since skin working tools were predominant there. Chipped stone and bone were sparse both within the hearth and on the peripheries. This supports the notion that the active life of this hearth was brief. F11-f was similar to its neighbour, F11-a, both having larger rock near the edges. There was also a similar opposition of large rocks on two sides, but the orientation was different, F11-f having them on west and east sides, while F11-a rock groupings were on north and south sides. Given this arrangement, it would have been possible for one person sitting between and to the south of the two hearths to have tended rocks in both F11-f and F11-c. Several rock refits were found in the one meter zone surrounding F11-f and included one piece from the south edge of F11-c. The conjoined rock linking F11-f and F11-c signifies contemporaneity or near contemporaneity for the two features. It is possible that one of the hearths was abandoned while remaining exposed so that its rocks were available for recycling on the other. In that case, it might be argued that differences in orientation were due to varying wind directions and (slightly) different times of occupation. Yet, it is clear that F11-f and F11-a were not perfectly equivalent. F11-f was smaller and not so long lived. Its subsurface lens was only about half as deep, and it contained only about a tenth the amount of fired rock and chipped stone.

Feature F11-g was a surface hearth which was partly exposed in the northwest corner of XU 3. It had a surface layer of black matrix about 55 cm in diameter and 4-5 cm thick, which was underlain by a lens of brown-black burned earth approximately 6 cm in thickness. On the surrounding surface, to about 45 cm beyond F11-g, was an zone of orange-pink soil with black patches. It had no underlying lens of burned soil. Resting on both the F11-g surface and surrounding orange-pink-black areas were a few fragments of fired rock, bone and chipped stone. The same sparse scattering of debris continued to a distance of about 50 cm south and east, beyond which there was a slightly denser concentration of larger bone and stone fragments. One fragment of a bifacial knife and one MURL were recovered in the vicinity of this hearth.

Lacking the whole context, it is difficult to interpret F11-g beyond saying that it was a hearth. The extensive surface burn surrounding the core area makes the hearth a bit unusual. The broken biface and MURL may be indications of activities such as meat cutting on the peripheries. The trace of broken bone, rock and chipped stone may be evidence for a limited amount of stone heating, food processing and consumption, and stone tool repair, but emphasis would have to be put on the word limited. One wonders if the hearth's main function may have been to provide heat to speed the drying of meat on an overarching rack. This might account for the extension of the hearth beyond its core. Perhaps coals were raked outward to diminish the amount of heat and to spread the application more evenly along the full extent of the overhanging meat.

Feature F11-h was a hearth with a concave surface and a deep subsurface burn. It was partly exposed in the southwest corner of XU 6. The central concave surface, about 7 cm in thickness, was a diffuse black-grey colour and supported four or five medium rock fragments. Charcoal recovered from F11-h indicates that the fuel included wood. Surrounding the central surface was a slightly raised perimeter layer of brown-black soil containing and supporting medium-size to small rocks, bone and chipped stone fragments. This fringe portion was about 11 cm thick at its maximum. In lower and inner parts it merged with a lens of brownish-orange soil which was about 12 cm deep and lay directly beneath the central black area but which feathered out under the browner edge portions. There was a sparse scattering of rock, bone and chipped stone up to a meter beyond F11-h to the north and east, and a slightly denser scatter of larger bone and stone fragments farther to the northeast. One endscraper, two MURLs and a bit of ochre were found among the debris in the vicinity of F11-h. The nearest neighbouring feature was hearth F11-i about 60 cm to the southeast.

Evidently, one of the F11-h functions was rock heating as shown by the presence of fired rock fragments and the churning of the surface layer. The concavity at the center was probably due to placing and removing rocks from the coal bed. The hearth was operated either quite intensely or else for a substantial time as indicated by the depth of underlying burned soil. Yet, the amount of debris in and around it was fairly sparse. The depth of disturbance at the margins was a little unusual as was the difference in colour from the center. Tools found in the vicinity are presumed to reflect hide working which would be a continuation of activities from the west side of hearth F11-f. Whether F11-h was contemporaneous with F11-f is a question we have not been able to answer.

Feature F11-i was another surface hearth. It was situated on the brink of the modern creek bank only about 60 cm southeast of F11-h, and was exposed during the excavation of Test Profile #3. The feature was about 80-100 cm in diameter and 10-15 cm in thickness. It had several pieces of fired rock resting on its surface layer of black and grey-white soil. That was underlain by a layer of red-brown burned earth. It seemed that this hearth was separate from F11-h, since there was no trace of it on Test Profile #3 which stood between the two features. F11-i was used to heat rocks, but not much else can be said from its limited excavation context.

Rock

Coarse rock from Layer XI includes 2,852 pieces weighing approximately 76.7 kg (Table 15.2). These numbers come from two separate analyses: (1) direct observation on smaller pieces in surviving collections, and (2) a combination of direct field observations and laboratory reconstructions for numbers, distribution, and weights of 67 large specimens having a total estimated weight of 40,020 g. The latter, having been set aside for special analysis, were accidently discarded during a move of SMNH collections in the early 1980s before analysis was finished. Our weight estimates are based on slides, planviews, fieldnotes and our experience with specimens of known weight. Our attempt to determine material types from slides was not completely satisfactory. Therefore, for discarded specimens, all materials were assigned to the unidentified category (Table 15.2). Nevertheless, we can say that gneiss, granite, basalt, dolomite/limestone and, possibly, sandstone and quartzite appeared to have been present — in other words, the same stone types that are found among surviving collections.

Table 15.2. Coarse rock from Layer XI.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
amphibolite	1	-	-	3	-	1	5
andesite	9	3	1	2	7	9	31
anorthrosite	-	-	-	-	3	-	3
basalt	6	-	-	12	9	-	27
chert	2	-	-	-	1	-	3
concretion	-	-	-	11	4	8	23
diorite	-	-	-	-	1	-	1
dolomite	1	-	-	-	-	-	1
gneiss	40	17	3	75	26	7	168
granite	241	21	15	871	130	71	1,349
grano-gneiss	1	-	-	503	11	-	515
greywacke	-	-	-	-	-	3	3
limestone	15	4	8	5	5	1	38
mudstone	-	-	1	-	3	-	4
quartz	-	-	1	4	1	-	6
quartz porphyry	-	-	-	3	-	-	3
quartzite	37	1	-	43	48	3	132
sandstone	26	1	9	72	42	5	155
schist	1	-	-	1	-	-	2
silicified sediment	6	3	2	-	-	-	11
syenite	-	-	-	-	1	-	1
unidentified	57	5	9	220	41	39	371
Total	443	55	49	1,825	333	147	2,852
Weight							
amphibolite	1	-	-	385	-	22	408
andesite	176	41	1	11	381	7	617
anorthrosite	-	-	-	-	8	-	8
basalt	24	-	-	63	77	-	164
chert	111	-	-	-	2	-	113
concretion	-	-	-	20	6	118	144
diorite	-	-	-	-	380	-	380
dolomite	3,112	-	-	-	-	-	3,112
gneiss	2,403	570	178	3,006	926	850	7,933
granite	4,206	274	331	6,116	1,798	1,799	14,524
grano-gneiss	420	-	-	362	345	-	1,127
greywacke	-	-	-	-	-	34	34
limestone	140	39	102	7	597	5	890
mudstone	-	-	1	-	22	-	23
quartz	-	-	3	15	2	-	20
quartz porphyry	-	-	-	270	-	-	270
quartzite	917	27	-	1,937	691	379	3,951
sandstone	71	4	47	273	1,656	36	2,087
schist	17	-	-	226	-	-	243
silicified sediment	13	2	11	-	-	-	26
syenite	-	-	-	-	8	-	8
unidentified	13,379	6,450	735	13,246	5,356	1,491	40,657
Total	24,990	7,407	1,409	25,937	12,255	4,741	76,739

One crumb of an unusual conglomerate was discovered in XU 6 (under unidentified category in Table 15.2). Catno 4794 has a very fine groundmass, a deep red to orange colour and, under 40x magnification, a somewhat platy appearance. It looks like a paste comprised either of hematite or haemoglobin. Speckled throughout the groundmass are tiny grains of silica. The piece has one slightly curved smooth side that resembles the encrustation of a cortex. The other side is fresh and open. The crumb is firm enough to withstand handling, but appears soft enough to be readily crushed.

The average weight of coarse rock specimens in Layer XI is 26.9 g which is far below the average for Layer X (319.2 g) and well below the site average (159.8 g). One implication is that rock firing was more intensive and led to a greater disaggregation than in many other layers. Another reason for the differences, especially in comparison to Layer X, is that coarse rock in Layer XI was used almost exclusively for firing whereas a substantial part of Layer X rock was used for other purposes such as construction of rock rings for boiling basins. It appears that granites and gneisses continued to dominate and that the range of types used reflects availability in local sources.

Stone Tools

Bifaces (n=4). Catno 4836 (Table 15.3; Figs. 15.5-15.6), a medium-size biface made of mauve quartzite, was found on hearth F11-a. A little larger than the palm of one's hand, it has lanceolate sides, a square base and a dull pointed end. The ventral face is nearly flat and has been shaped by a single scar representing the underside of the large flake from which the tool was made. Crude marginal retouch extends 5-13 mm onto the ventral face from the edge. The dorsal face has been more extensively modified with marginal flake scars extending 11-28 mm from the edge. A 17 mm segment of the edge at the "pointed" end is blunt, and appears to have been the striking platform for the expanding flake from which the tool was made. The retouched edges vary from slightly to moderately sinuous and there is a large sharp "nick" near the middle of one side. The great majority of the edge(s), however, is rounded by light crushing and abrasion. Rounding is centered on the crest but extends onto both faces for 1-2 mm and is present in varying degrees along both sides, the basal edge and one basal corner. Using a microscope we discovered a granular rusty red substance adhering to crevices at or very near the edge in several places. This looks like haemoglobin residue. The combination of shape, wear and (suspected) blood residue is what might be expected for a butchering tool that was part knife, part cleaver.

Edge pieces of two similar tools were also recovered (see Fig. 15.6). Catno 4614 is the basal corner of the same kind and size of biface knife. It is made of pink-mauve-brown quartzite and has a rounded edge (crushed and abraded) with minute traces of reddish brown residue. Its break, along a hinge fracture, started out perpendicular to one face and then curved and feathered out on the other. This suggests snapping by a levering action. Catno 4478 is also an edge segment (position undetermined) of a biface knife, made of white-grey quartzite. It, too, has a rounded edge worn by crushing and abrasion with microscopic traces of reddish brown materials in crevices and rough spots

Table 15.3. Stone tools from Layer XI.

Type	Catno	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
biface	4478	1	3.2	31	14	8	quartzite	n	15.6e
biface	4614	3	4.2	36	21	7	quartzite	n	15.6f
biface	4687	4	0.3	15	5	5	chert	n	15.6d
biface	4836	1	120.7	98	55	15	quartzite	y	15.5a
endscraper	4520	1	3.3	23	20	5	petrified wood	y	15.6h
endscraper	4521	1	1.2	16	17	4	Knife River Flint	y	15.6j
endscraper	4561	2	7.5	37	31	6	jasper	y	15.6l
endscraper	4564	2	4.2	32	20	4	silicified sediment	y	15.6g
endscraper	4679,5138	4	6.3	29	25	7	Knife River Flint?	y	15.6o
endscraper	4723	5	1.2	15	16	5	chert	n	15.6i
endscraper	4787	6	4.7	32	22	5	chert	y	15.6p
endscraper	4996	5	139.4	97	70	18	andesite	y	15.5b
endscraper	5022	5	6.4	28	23	8	petrified peat	n	15.6n
endscraper	5024	5	11.6	36	30	9	petrified wood	?	15.6m
MURL	4490	1	1.6	26	18	2	petrified wood	y	15.7d
MURL	4500,4501	1	1.8	41	12	3	jasper	y	15.7a
MURL	4513	1	0.9	29	16	2	silicified sediment	y	15.7c
MURL	4514	1	3.6	38	22	2	silicified sediment	y	15.7e
MURL	4531	1	4.1	40	31	5	petrified peat	y	15.7j
MURL	4533	1	9.8	26	31	9	petrified peat	y	15.7k
MURL	4563	2	2.8	29	18	5	petrified peat	y	15.7f
MURL	4641	3	1.0	25	22	3	petrified peat	?	15.7c
MURL	4725	5	4.4	27	26	7	Swan River Chert	n	15.7g
MURL	4773	6	146.7	115	49	26	quartzite	?	15.5c
MURL	4775	6	1.9	20	23	3	Swan River Chert	n	15.7g
MURL	4847	2	14.8	45	28	10	Swan River Chert	?	15.7n
MURL	4933	4	314.5	159	48	38	amphibolite	n	15.5d
MURL	5023	5	5.1	39	19	8	Swan River Chert	y	15.7m
MURL	5038	6	15.3	57	36	6	petrified wood	y	15.7p
MURL	5232	1	9.1	45	26	9	petrified peat	?	15.7o
MURL	5252	4	1.6	22	14	6	chert	?	15.7i
MURL	5257	4	7.2	31	28	10	petrified peat	?	15.7l
projectile point	4526	1	0.3	13	11	2	silicified sediment	n	15.6b
projectile point	4562	2	1.6	27	17	4	jasper	y	15.6a
projectile point	5259	4	2.3	20	18	6	petrified peat	n	15.6c

near the edge. Like catno 4614, it has separated from the parent tool along a hinge fracture. A fourth bifacial piece, catno 4687, is very small, and it is difficult to judge whether it was part of a biface knife or some other kind of tool. It is made of an amber-brown chert; has a lightly polished, fairly sharp edge; was broken with a hinge fracture; appears to have been a rounded corner or point section of the tool; and is smeared with a rusty amber-brown residue from edge to break.

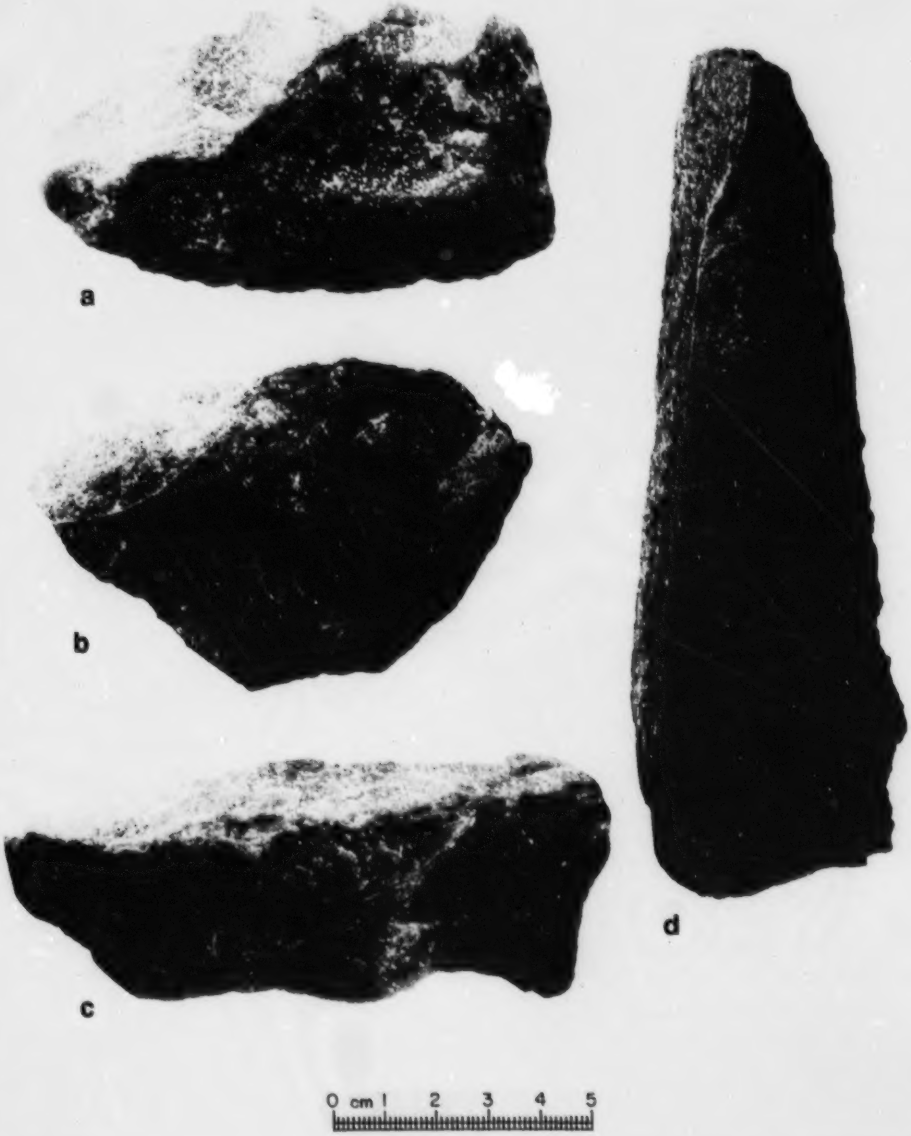

a
b
c
d
0 cm 1 2 3 4 5

Figure 15.5. Biface (a), endscraper (b), and MURLs (c-d) from Layer XI.

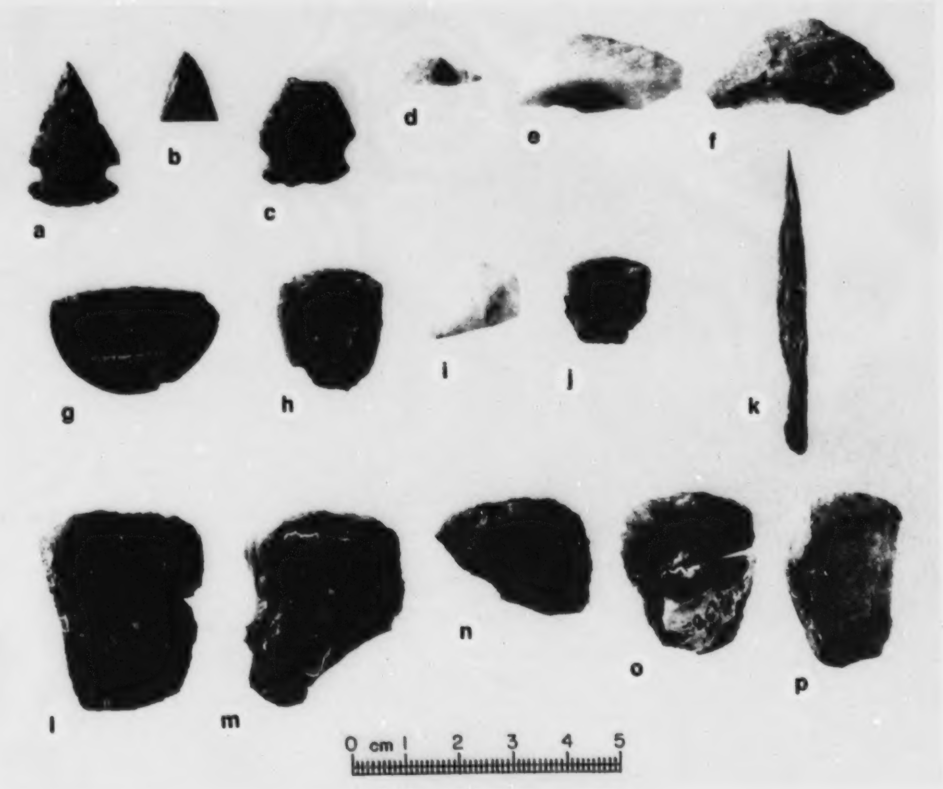


Figure 15.6. Projectile points (a-c), bifaces (d-f), endscrapers (g-j, l-p), and a bone awl or needle (k) from Layer XI.

Endscrapers (n=10). The endscrapers from Layer XI are a diverse lot (see Figs. 15.5-15.6). The features that all have in common are: (1) evidence for scraping use on a steep-edged distal end of a (usually expanding) flake, and (2) a working edge with a slightly convex shape (in planview). Weights vary from 1.2 to 139.4 g; materials from flint to andesite. Two are made on decortication spalls, one ona split pebble, and the rest on flakes derived from more extensively worked cores. Three of the endscrapers were broken, two of them quite clearly during resharpening since parts of their working edges are sharp and freshly flaked while adjoining parts are rounded and polished. In one case we recovered two matching pieces (catnos 4679 and 5138) and were able to refit them into the roughly plano-convex form of the complete tool. In all but one case the distal "working" end bears steep unifacial retouching. Catno 4564, the split pebble, appeared at first glance to have retouching only on its lateral edge. Under closer examination, however, we found that both the unretouched distal end

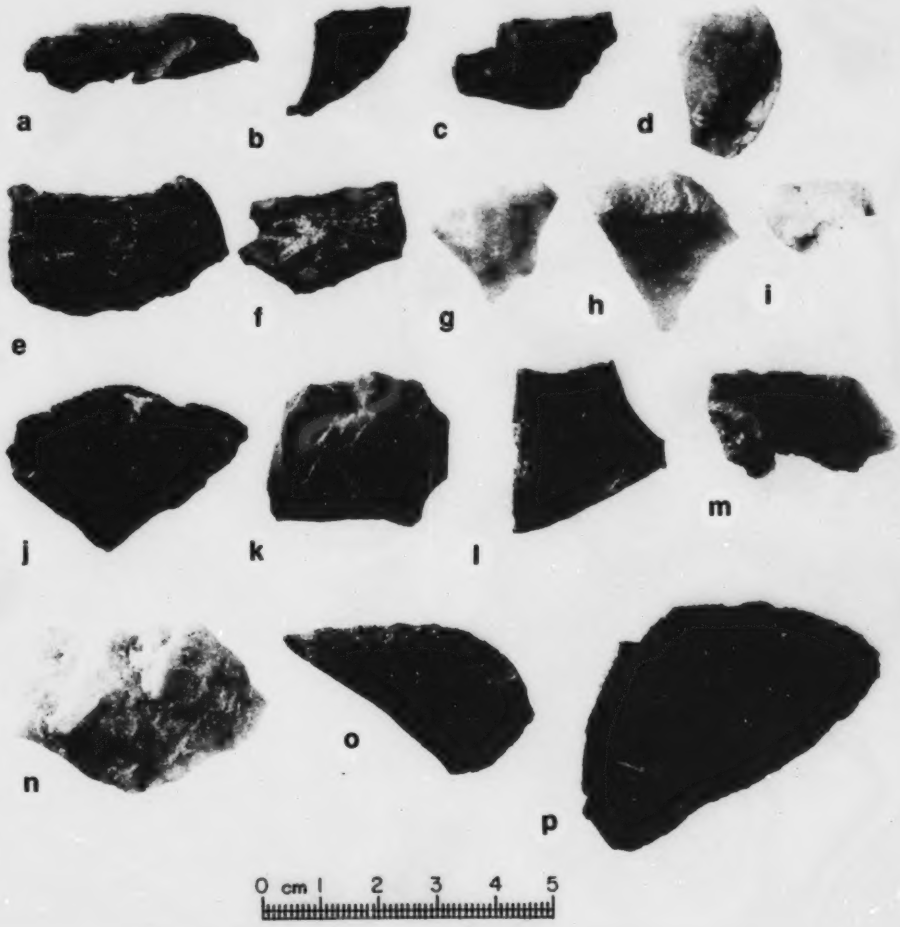


Figure 15.7. MURLs from Layer XI.

and the retouched side show polish and rounding. Moreover, the light to moderate rounding and polish on the end is at least equivalent to that on the side. Thus, even the split pebble was used as an endscraper. Most of the specimens have retouching on at least part of one lateral edge. Five have retouching and/or use wear on both lateral edges. There is light polish, in some cases light crushing, on most lateral edges. There are also traces of a granular rusty red material adhering to the edges and in crevices of step fractures near the edges (especially catnos 4787 and 5238). Similar residues are occasionally seen on flake scars of distal ends, but usually in lesser amounts. If the residues are blood, then it would appear that the surfaces being scraped, or at least the hands which manipulated the stone scrapers, were bloody.

MURLs (n=18). There are several kinds of tools in this miscellaneous category (see Figs. 15.5, 15.7). The largest item, catno 4933, is a narrow pick-like spall of amphibolite. It has one naturally sharp edge most of which is modified by a combination of crude unifacial retouch, light edge crushing and three widely spaced modestly crushed concavities (nicks). This tool could have served as a cleaver on a moderately hard substance such as wood bark or dried meat. No residue is present on its edge. Another large item, catno 4773, has a naturally sharp, thin, sinuous edge with light crushing and polish extending up to 1-2 millimeters on each side. This modification spans the length of the edge and is accompanied by very sparse granular red residues. We presume that the tool was used as a knife or cleaver on a slightly bloody, soft and fairly thin substance. Catnos 4847 and 5257 are fragments of larger pieces with naturally sharp edges bearing crushed and rounded edges similar to that of catno 4773. Three other specimens, catnos 4531, 5038 and 5252, have straight to slightly sinuous bifacially retouched edges. The edges are lightly crushed, abraded and polished within 1 mm of the edge centerline. In two cases they have sparse amounts of granular rusty red material adhering to the crevices of step fractures within 3 mm of the edge. In the third instance (catno 5252), there is a band of the adhering substance 3-4 mm wide running along the edge on both faces. These tools were probably also used as knives. Thin flakes with minute (1.5 mm) overlapping unifacial retouch along one or more edges represent another type of tool. Catnos 4490, 4500-4501, 4513, 4514, and 4641 fall into this category. In four cases the edge is straight or slightly convex; in the fifth (catno 4514) it is concave. Though the retouching is minute, it is deliberate and not simply the result of use wear. This is revealed by catno 4500-4501, a refitted specimen which broke during sharpening. All of the edge is sharp and freshly retouched except for one small well worn and projecting edge remnant near the middle. The break is right beside it. Evidently, the tool was broken in an attempt to remove that last edge segment. Several of these thin pieces have unretouched, but use-crushed and polished edges. Three of them have a granular rusty red substance clinging to the crevices of the edges and, in the case of catnos 4490 and 4514, the adhering materials are spread over the whole dorsal face with traces on the ventral face as well. These razor-blade-like tools probably served for cutting a soft bloody substance such as meat. Catno 4775 is yet another type of tool, possibly a perforator. It is 3 mm thick and has two steep unifacially retouched edges that converge at an angle of about 40°. The tip is broken off at a diagonal angle along a hinge fracture. There is a little rounding and polish on the edges along with two kinds of residue — small rusty red smears and minute buff-coloured dough-like adhesions. The residues appear on the flake scars of the retouched edges, on the dorsal face and to a small degree also on the ventral face. Finally, the balance of the MURLs (catnos 4533, 4563, 4725, 5023 and 5232) fall into a truly residual category being mainly flakes or shatter with a fairly steep thick edge of which at least a one cm segment bears at least 3 unifacial flake scars.

Projectile points (n=3). We found one complete and two broken projectile points in Layer XI (see Fig. 15.6). The complete specimen, catno 4562, has a convex base, notches placed either at or just above the basal/lateral junction, and straight edges that converge at a sharp point making an angle of about 50°. All of the edges are sharp and appear to be freshly chipped without attempts at edge smoothing. The material contains faults which, to judge from the uneven surfaces of flake scars and numerous step fractures, made the chipping difficult. Thus, although the point appears complete and functional, it may have been discarded before the finishing touches were added. Catno 5259 is similar in shape except that the tip has snapped off and there are a couple of chips removed from the base, possibly the result of end shock from a force applied at the tip. Its material is also full of faults which made chipping difficult and which caused many step fractures near the edges. On this specimen there are signs of basal grinding on the surviving portions of the original basal edge, but none on the lateral edges. There are no adhering residues on either point. The third specimen, catno 4526, consists solely of a projectile tip broken along a fracture plane which is perpendicular to both faces and to the long axis of the point. Edges converging at an angle of about 42° create a sharp tip. The thickest part of the tip fragment, at the middle of the fracture, is only 2 mm thick. This thinness may have contributed to the breakage. Nevertheless, it seems that the point had served its primary role in dispatching one of the animals represented by bones in the site, because the edges and both faces of the tip are speckled with residues. One type is buff-yellow in colour, pasty in consistency (under magnification) and present in sharp fracture crevices. Another type, a bit sparser, is granular and rusty red with a similar distribution. These may be blood residues. Some crevices also contains traces of a powdery white residue which we suspect to be calcium carbonate presumably precipitated from soil water. Both specimens sufficiently complete to allow measurements are arrowheads according to Thomas' (1978) discrimination equations.

Comparisons: The convex-based, straight-sided projectile points found in Layer XI are a distinctive type which has been noticed in other Northern Plains sites but, to our knowledge, not distinguished as a separate type. Similar points have been found as minor constituents of Besant assemblages on the northern Plains, (cf. Gruhn 1971:153 [nos. l,o,v]; Forbis 1962:107 [nos. g,h,i,k,s]; Ramsay 1991:332 [nos. 674, 3021], 335 [nos. 10873, 10890], 338 [no. 10887]; Reeves 1983a:54 [nos. 4, 6]; Wettlaufer 1960:40 [no. 3]). Wettlaufer (1960:41-42) simply lumped this type into "Besant Side-notched." Forbis (1962:106-109) proposed the division of a similar group of specimens which he found with Besant materials at the Old Women's site into one Besant variety (Variety 4), two styles (LM-1, LM-2) and a Texan type (Ensor). Reeves (1983b:54-57) sided with Wettlaufer and provided a detailed definition that allows for the inclusion of concave, straight-based and convex forms into a single Besant Side Notched type. He noted that the straight-based form is the most common. Most Northern Plains archaeologists have accepted the very broad Wettlaufer/Reeves definition, although some have argued for a regional variant they call Sonota (Neuman 1975; Syms 1977), while others (Kehoe and Kehoe 1968; Kehoe 1974; Reeves 1983b) have used the name "Samantha" for Besant forms which seem to fall into the arrowhead size but are otherwise similar in form to the broad Besant Side-notched type.

A remarkably similar convex-based, straight to slightly convex-sided projectile point has also been found in deposits that have been attributed the Pelican Lake complex (cf. Wettlaufer 1955:97 [no.1], 107 [no. 2]). Some authors have had doubts about how to attribute small samples or single specimens of such point forms (cf. King 1961:51 [no.a]; Kehoe 1974:104 [Bracken variety]). Generally such doubts have been left unresolved. Reeves (1983b:57-59) provided the clearest definition of the Pelican Lake Corner Notched type creating a broad category including basal shapes that are convex (most common) to straight to concave (rare). The key features, according to Reeves, are barbed shoulders and diagonal or corner notching. Reeves (1983b) also attempted definition of eight regional Pelican Lake subphases based on vague environmental and activity distinctiveness criteria. Of equal interest, however, is Reeves' (1983b:58) observation that Pelican Lake forms occur not only in Pelican Lake components, but also in those belonging to the Besant, Avonlea, Valley, Loseke, Keith, Parker and Willowbrook phases. Since all of these tend to post-date Pelican Lake, excepting Willowbrook which is contemporary, this broad usage of the type could be written off as the "influence" of earlier peoples on later ones, or as the recycling of relics. In any case the cross-cutting temporal distribution has not received much attention.

The type can also be found in older components. If one examines the archaeological record of Colorado, for example, one finds similar convex-based, straight to slightly convex-edged forms in Complex D of the LoDaisKa Sequence dated at 4880±250 BP; in the Hungry Whistler site dated to 5520±190 BP; and in Zone F of the Magic Mountain Complex dated at more than 4900±250 BP (see Cassells 1983:98 for illustrations and additional references). Similar styles continue into the Horse Fly Phase (500 BC- AD 1) and the Ironstone Phase (AD 1-700) of the Uncompahgre Plateau Sequence of Colorado (see Cassells 1983:88 for illustrations and references). These last two phases are contemporary with Pelican Lake and Besant of the Northern Plains. Variants of the type even continue into more recent phases of the Colorado sequence (cf. the Camel Back Phase, Cassells 1983:88). Much closer to the Sjovold site, the Bracken site (King 1961; Pendree 1980) exhibits a great many similarities to the Layer XI assemblage - in respect to projectile points, biface knives, uniface knives and endscrapers, age and rough geographic location in the far northern Plains. This is not the place for a thorough study of the temporal and geographic distribution of the convex based type, its associations and variants. Suffice it to say that there is compelling evidence to support the notion that the type is not diagnostic of a particular complex or locality.

Given this background we propose to name the Sjovold Layer XI projectile point type, but leave the complex(es) to which it belongs unidentified, except to note that, in the northern Plains, it dates roughly to 1300-3000 BP and appears in both the Pelican Lake and Besant series. We offer the type name "Bratton" after the Bratton glacial channel in which the Sjovold site is situated. The Bratton projectile point type has a convex base for which depth of convexity (the perpendicular distance between a line joining the two points of basal juncture and the apex of the basal edge) is more than 1 mm and less than 7 mm. It has two notches whose openings either encompass the points of juncture of the baso-lateral edges or else are situated no more than 1 mm above those points on the lateral edges. This definition makes no distinction between corner-notching and side-notching since both can appear on a single specimen. The lateral edges are slightly convex to straight.

Table 15.4. Chipped stone debris, excluding cores, Layer XI.

Material	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
agate	2	1	-	-	-	1	4
chert	7	3	6	3	3	6	28
chalcedony	1	-	1	-	-	-	2
Gronlid Siltstone	2	-	-	2	1	-	5
Knife River Flint	-	-	-	-	1	-	1
obsidian	-	-	-	-	2	-	2
petrified peat	59	3	12	49	10	14	147
petrified wood	4	5	1	-	-	2	12
quartzite	41	5	5	23	17	12	103
quartz	20	3	-	30	5	1	59
silicified sediment	8	2	-	6	-	3	19
Swan River Chert	30	2	16	43	13	8	112
unidentified	-	-	-	-	-	1	1
Total	174	24	41	156	52	48	495
Weight							
agate	0.2	0.1	-	-	-	0.5	0.8
chert	7.6	7.7	2.2	1.2	3.6	3.7	26.0
chalcedony	0.8	-	<0.1	-	-	-	0.8
Gronlid Siltstone	2.0	-	-	4.4	0.1	-	6.5
Knife River Flint	-	-	-	-	1.7	-	1.7
obsidian	-	-	-	-	0.8	-	0.8
petrified peat	85.8	7.8	7.0	53.8	51.9	10.8	217.1
petrified wood	8.7	6.7	1.1	-	-	4.1	20.6
quartzite	319.7	2.4	1.8	181.5	37.4	97.6	640.4
quartz	43.2	33.7	-	73.6	19.9	11.1	181.5
silicified sediment	17.2	2.2	-	5.5	-	0.9	25.8
Swan River Chert	38.1	6.9	9.3	79.9	142.4	11.9	288.5
unidentified	-	-	-	-	-	0.1	0.1
Total	523.3	67.5	21.4	399.9	257.8	140.7	1,410.6

Chipped Stone Debris

The dominant chipping material in Layer XI, excluding cores, is quartzite at 45.4% of the total weight (Table 15.4). That is followed by Swan River Chert at 20.4%, petrified peat at 15.4 %, and quartz at 12.9%. These are the same four materials that predominate in Layer X, but in slightly different proportions. Virtually the same minor materials are also present in both layers. Once again, the uses of quartzite, petrified peat, and possibly quartz, indicate reliance on local river valley resources, while the Swan River Chert may be an indication of commerce to the northeast. As to degree of reduction, quartzite (at 6.2 g per specimen) and quartz (3.1 g) were rendered into pieces of

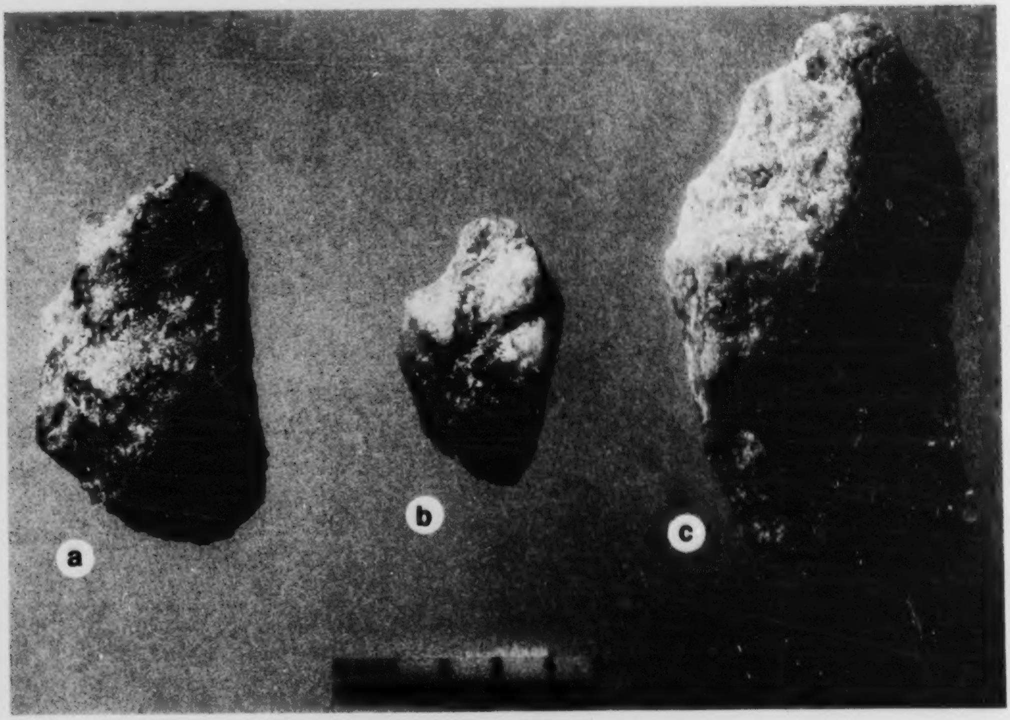


Figure 15.8. Large chipped stone cores from Layer XI.

Table 15.5. Chipped stone cores from Layer XI.

Type	Catno	XU	Weight	Size*	Material	Fig.
bipolar	4729	5	2.5	a	chert	15.9a
bipolar	4732	5	2.4	a	silicified sediment	15.9b
bipolar	4739	5	4.1	b	petrified wood	15.9f
bipolar	4788	6	21.0	b	chalcedony	15.9e
bipolar	4828	1	335.0	d	quartz	15.8c
bipolar	5303	4	137.2	c	quartz	15.8a
bipolar	5306	4	4.6	b	Swan River Chert	15.9c
bipolar	5314	4	6.8	b	Gronlid Siltstone	15.9d
bipolar	5344	5	3.2	a	chert	15.9g
spall	5041	1	50.9	c	quartz	15.8b

*** size refers to categories based on greatest length: (a) 13-25mm, (b) 26-49 mm, (c) 50-100 mm, (d) 100-149 mm, and (e) 150 mm and larger.**

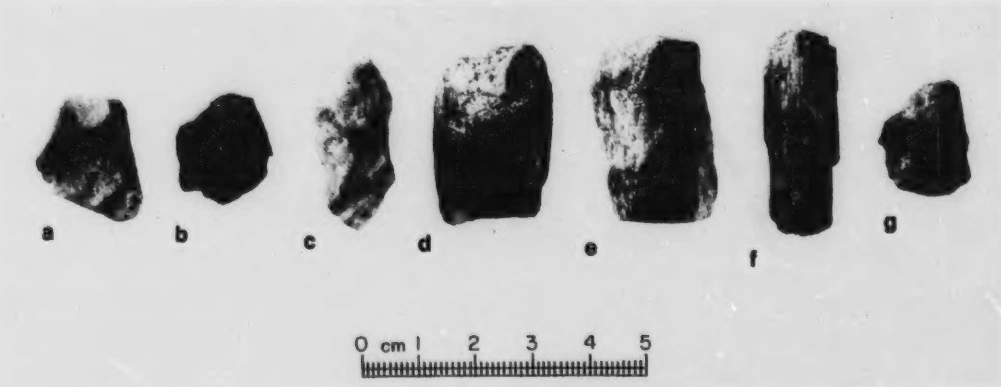


Figure 15.9. Small chipped stone cores from Layer XI.

large size; medium-size (1.0-2.9 g) includes Swan River Chert at 2.6 g per specimen, petrified wood at 1.7, Knife River Flint 1.7, petrified wood 1.5, silicified sediment 1.4, Gronlid Siltstone 1.3; and the rest is small.

There are ten chipped stone cores in Layer XI (Figs. 15.8-15.9, Table 15.5). One quartz core is of the spall variety; all others are bipolar. The distribution of flakes, shatter and cores shows that the majority (66% by number) was in XUs 1 and 4 within and around hearth F11-a. There was a secondary concentration (12%) in XU 5 around hearth F11-f and lesser scatters elsewhere. Thus, the clear pattern was one of association with hearths. Chipped stone tools had a similar distribution with 19 of 37 tools (51%) in and around F11-a, and seven tools (16%) in and around F11-f. Most tool materials are represented among the debris (items made of amphibolite and andesite have comparable debris among the coarse rock). Three tools made of jasper are exceptions. Although quartzite, at 45% by weight, is dominant among the debris, petrified peat, at 22% by number, is dominant among tools. Quartzite tools represent only 11% of the total. The picture which emerges from a study of tools and chipping debris suggests a fairly wide range of manufacturing and stages of use life: (1) sharpening (or reshaping) of imported tools and site-made tools, (2) manufacture of new tools some of which were exported, and (3) discard of worn out or disabled tools, some of which were made at the site. In considering the three most dominant materials, one notices that quartzite was used mainly for manufacture of bifaces, Swan River Chert for cutting edges (MURLs and a biface), and petrified peat for almost every kind of medium and small chipped stone tool.

Bone Tools

An unclassifiable large mammal bone splinter from XU 6 (catno 4771, Fig. 15.6k) has been shaped for use as an awl or as an uneyed needle. It is a slender, delicate specimen that exhibits local

Table 15.6. Vertebrate remains from Layer XI.[a]

Size, Taxon	XU 1	XU 2	XU 3	XU 4	XU 5	XU 6	Total
Number							
6, Bison	26	13	15	31	12	20	117
5-6, mammal	65	40	34	27	32	23	221
3, Rabbit or Hare	*3	-	-	-	-	-	3
3, mammal	1	-	-	-	-	-	1
-, mammal	827	97	198	948	223	253	2,546
Common Raven	1	-	-	-	-	-	1
Total	923	150	247	1,006	267	296	2,889
Weight							
6, Bison	1,923.8	830.6	1,101.0	1,238.9	1,647.1	416.9	7,158.3
5-6, mammal	290.3	216.6	259.0	200.1	275.5	123.5	1,365.0
3, Rabbit or Hare	0.3	-	-	-	-	-	0.3
3, mammal	0.1	-	-	-	-	-	0.1
-, mammal	193.4	51.3	93.4	558.1	179.5	125.0	1,200.7
Common Raven	0.2	-	-	-	-	-	0.2
Total	2,408.1	1,098.5	1,453.4	1,997.1	2,102.1	665.4	9,724.6

a. Superscript (*) signifies that these elements are thought to be intrusive into this layer.

polish but no apparent striations; however, the latter may be obscured by pervasive rootlet etching.

Faunal Remains

A radiocarbon sample (S-2058) removed 290 g of bone from Layer XI prior to the analysis with contributions from four excavation units: XU 1, 100 g; XU 2, 49 g; XU 4, 69 g; XU 5, 72 g. The remaining material is shown in Table 15.6.

Bison, NISP=117: see Table 15.7. MAU reaches a maximum of 3.0 based on femur and tibia, and the most parsimonious accounting is that MAU=1.0 for each age/gender grouping (calf, cow, and bull). Cranial and axial elements are under-represented, and there are no forelimb elements below the wrist. However, it appears that whole hind limbs were retrieved. The assemblage is unusual in containing two complete long bones — femur and tibia — both of which are assigned to the adult cow group.

One bison rib exhibits a cluster of scrape marks that might be due to trampling rather than defleshing. Humerus, tibia and metatarsal shafts exhibit well preserved impact scars. Tooth marks are present on nine elements. Carnivores gnawed on a thoracic centrum, a proximal radius, an ulnar olecranon process, two femoral heads, both ends of the complete femur, the proximal end of the

Table 15.7. Bison elements and fragments from Layer XI.

Element	NISP	MNE	Calf	Cow or Calf	Cow	Bull
Tympanic bulla	1	1	-	-	-	-
Maxilla[a]	4	2	1	-	-	-
Mandible[b]	14	3	-	-	1	1
Atlas	1	1	-	1	-	-
Cervical 5	1	1	-	-	-	-
Thoracic	1	1	-	-	-	-
Lumbar	1	1	-	-	-	-
Sacrum	1	1	-	-	-	-
Rib	19	19	-	-	-	-
Scapula	5	4	-	-	-	1
Humerus	8	4	-	1	-	-
Radius	7	4	-	1	-	1
Ulna	6	4	1	-	-	-
Ulnar carpal	1	1	-	1	-	-
Carpal 4	2	2	-	2	-	-
Innominate	2	2	-	-	-	-
Femur	10	6	1	-	1	1
Tibia	15	6	1	2	1	-
Lateral malleolus	2	2	-	2	-	-
Talus	1	1	-	1	-	-
Calcaneus	1	1	-	-	-	1
Tarsal C+4	2	2	-	1	-	1
Tarsal 2+3	2	2	-	2	-	-
Metatarsal III+IV	7	4	-	-	2	1
Hind 1st phalanx	3	3	-	1	-	2

a. one maxilla in age group B. b. ♀ mandible in age group 8, ♂ in age group 6?

complete tibia, and the tuber calcis of the calcaneus. Rodents gnawed on one rib shaft and one tibia shaft. Of 51 weathered specimens, 31 have reached Stage 2. All of the bones are etched by rootlets, and etching is moderate on 59 specimens.

Size 5-6 mammal, unidentified, n=221: 29 tooth, 33 rib, one scapula, 158 long bone shaft fragments.

Rabbit or Hare, NISP=3: distal radius, ischium, talus. These bones have a distinctive red-brown stain and are probably intrusive. The radius has been pitted and thinned by digestion.

Size 3 mammal, unidentified, n=1: long bone shaft fragment.

Unidentified mammal, n=2546: fragments of which all but 55 are less than 4 cm in length and

Table 15.8. Modified vertebrate remains from Layer XI.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	1	-	10	-	51	117	15	13	23	49	17	117
5-6, mammal	-	-	-	-	*	*	29	20	59	113	-	221
3, Rabbit or Hare	-	-	-	1	-	-	-	-	-	2	1	3
3, mammal	-	-	-	-	-	-	-	-	-	1	-	1
-, mammal	1	711	2	-	*	*	-	*	*	*	-	2,546
Common Raven	-	-	-	-	-	1	-	-	-	-	1	1

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

the remainder are 4-10 cm long. One cut specimen is the awl or uneyed needle, and two fragments are tooth-marked. Burned pieces include 448 charred and 263 calcined bones, 85% of which occurred in XUs 1 and 4 in association with a hearth (Feature F11-a).

Common Raven, NISP=1: hind distal phalanx.

Snails: Six small gastropods were recovered from screenings.

Plant remains: We collected two charcoal samples, totalling 18.5 g, from surface hearth F11-a. One of these, including fragments of Manitoba maple (*Acer negundo*) charcoal (R.J. Mott, pers. comm. in 1990), was used as a radiocarbon sample (S-3365; see Chapter 3). Other charcoal samples came from hearth F11-h (19 pieces, 2.7 g) and from general screenings in XU 4 (5, 3.9 g).

Discussion: Bison of three age/gender groups — a bull, a cow, and a calf — are represented in Layer XI. Many of the limb bones were fractured when fresh for marrow retrieval, but it is interesting that two complete hind limb bones are present. Of these, the femur had been cracked when fresh, but it was not broken open. One feature in XU1, F11-d, appears to contain the residue of bone-grease manufacture.

The assemblage was lightly ravaged by carnivores, but, as in Layer X, there is no digested bone to represent carnivore consumption. Several lines of evidence — high frequency of dry-state fractures, presence of rodent-gnawing, and relatively advanced weathering — suggest that the Layer XI bones lay on the surface for a relatively extended period prior to burial. Ubiquitous and fairly heavy rootlet etching also indicates a long period in the active layer and therefore a slow rate of sedimentation.

We believe that the red-brown leporid bones are intrusive, and their colouration is reminiscent of the cottontail elements in the loosely infilled (badger?) burrow encountered in XU 4, Layers IV-VI.

However, the radius from Layer XI has a fused distal epiphysis indicative of an older age at death, and these remains must have intruded via a different pathway. Even though the raven phalanx was found in the same excavation unit as the leporid elements, we believe that rootlet etching on the former shows that it is contemporaneous with Layer XI.

Interpretation of Layer XI

Initially, there was reason to doubt that all the features in Layer XI were contemporaneous with one another, because no less than five hearths were present in our limited exposure (23 m^2). However, subsequent analysis has shown that some hearths functioned in substantially different ways, and some share refitted fragments of materials which tie them together. Thus, we are inclined to believe that the hearths were contemporaneous or very nearly contemporaneous features.

The center of activities seems to be a group of features, toward the east end of excavations and just a meter north of the present creek bank. Included were hearth F11-a, rock clusters F11-b and F11-c, hearth F11-f, and the fairly dense scatter of debris between and south of the hearths. The dominant feature in this group, F11-a, was a substantial medium-size hearth with rock clusters on north and south edges and an extension to the east. Charcoal recovered from F11-a indicated that its fuel was Manitoba Maple wood. Bone and chipping debris within the hearth showed that it served as a minor trash disposal area. The subsurface of F11-a was disturbed and contained fragments of fired rock, chipping debris, bones, charcoal and ash. Evidently, it had been churned during the rock-heating cycle. The body of F11-a was apparently insufficient for this purpose, because an extension in which similar functions were performed was added to the east. A cluster of five large stones on the north edge of F11-a seems to have been a stone-warming station and possibly an ad hoc platform for bone roasting, breaking, joint disarticulation and possibly meat stripping by someone sitting immediately to the north. A medium-size biface found on the hearth was probably used in this work. Other activities in this vicinity included stone tool manufacture (nine of ten cores were found in and around hearths F11-a and F11-f), skin scraping (two endscrapers), and cutting (three MURLs). One projectile point tip found north of F11-a probably came out of meat brought to fireside. A complete projectile point among the debris on the south side of the hearth may have been roughed out elsewhere and discarded among the hearth debris without being used. Alternatively, it, too, may have been brought to the hearth in meat. In any case, this point was not made or sharpened at fireside since there was no jasper chipping debris there to match its material of manufacture.

The F11-c rock cluster on the south edge of F11-a appears to be the remains of a charge of fired rock. Although this cluster rested on F11-a, one of the rock fragments on its southern fringe conjoins a piece found in hearth F11-f. Thus, it seems that some rocks were being heated on both hearths, possibly by a person sitting among sparse debris between and south of the hearths. F11-f was a miniature version of hearth F11-a. Its fired rock had a slightly different orientation (west and east sides). There was an area of sparser debris at its southeast corner where a person could have sat tending both F11-f and F11-a. Otherwise, the scatter of stone and bone debris south of F11-f and F11-a was fairly dense and seems to have been a toss zone for materials coming from both hearths. West of F11-f was an area about 8 m^2 containing a variety of occupation debris among which larger bison bone elements were prominent. The southeastern part of this area, near hearth F11-f, contained four endscrapers and two MURLs which were the strongest indications of hide scraping and soft material cutting found in the layer. The same hearthside area contained four chipped stone cores and a bit of chipping debris indicative of stone tool manufacturing.

Three other hearths on the west edge of excavations, F11-g, F11-h and F11-i, were only partly exposed and are difficult to interpret. Together they make a south to north arc with the concavity facing hearth F11-f roughly 2.5 m to the east. They contain evidence for fairly intense burning, but exposed parts of their surrounding context contained less in the way of tools and debris than was found around F11-a. The northernmost hearth, F11-g, may have had something to do with drying a rack of meat. The others were used at least for stone heating, but a full picture of their functions is beyond our grasp. A little more than a meter north of the F11-a complex was another little group consisting of a patch of pulverized bone (F11-d) and a neighbouring cluster of fired rock fragments in the center of which was a battered dolomite cobble (F11-e). We suspect that these were the remains of a bone breaking and boiling operation, possibly to make bone grease, and possibly operated by the same person who sat north of F11-a and F11-b.

The whole group of Layer XI features appears to have been part of an outdoor creekside work area, probably used for the routine tasks associated with bison carcass processing — skin dressing, meat stripping and drying, bone breaking for marrow extraction and, possibly, also for grease extraction, plus stone boiling for primary consumption (meals) and, perhaps, also for grease manufacture. The area seems too large, and too close to the creek to have been contained within one dwelling, and too well integrated to have be divided among two or more dwellings. Most of the tools found in excavation were those which would have served in carcass processing. Consequently, we suspect that the primary occupants of this area were women (who traditionally performed such tasks in Plains Indian societies). If arrowheads can be taken to signify the presence of men, then men were clearly present in the group. However, even though three projectile points were found among the debris, they could have been introduced in meat and, therefore, can not be taken as a sign that men were co-habitants in this particular work area.

Subsistence, at this worksite, was based on bison hunting. Faunal remains include parts of at least three animals — a bull, a cow, and a calf. This amount of bison would sustain a couple of extended families, perhaps 14-16 people, for a few days to a couple of weeks depending on what amounts were consumed fresh or preserved for future use. The arrowheads suggest that animals were dispatched with bows and arrows, probably near the site. Other local resources used by the occupants include quartzite, petrified peat, andesite, amphibolite and possibly Swan River Chert for making stone tools; Manitoba Maple wood for fuel; and coarse rocks such as granite, gneiss, quartzite and sandstone for stone-boiling. Exotic materials in the site are Knife River Flint, obsidian, Gronlid Siltstone and perhaps also the yellow jasper, all found in very small quantities. It is possible that the exotic materials are reflections of trade or travel to the southeast, southwest, and northeast where such exotic materials are known to be abundant. However, it is also possible that their presence merely reflects reuse of imported materials picked up by Layer XI inhabitants from other sites in the area.

The identity of the occupants is a puzzle. We can see that the projectile points are a convex-based type which apparently belongs to the period extending roughly from 1300-3000 BP (cal.) in the northern and central Plains. Similar projectile points have been attributed to Besant and also the Pelican Lake series and, in the west-central Plains, to other archaeological entities. Thus, this type, even though quite distinct, is not unique to one phase or place. Such a realization has profound implications for the traditional archaeological practice of identifying preceramic archaeological complexes in terms of (unique) projectile point types. Though the practice has been fundamental to cultural classifications at gross initial stages of investigation, it fails us here. Our contribution toward an eventual clarification of the archaeological complexes involved is to distinguish this particular type with its own type name, Bratton, while noting that it is a substantial constituent of the Pelican Lake series, while also being a minor part of Besant.

Our estimate of the general age of occupation is between 550 and 250 BC (cal 2500-2200 BP; Table 3.6). The season of occupation was one in which snow did not interfere with discovery of local raw materials, such as chippable stones and boiling rocks, which were needed for site activities. It was also a time of fair weather when people could work at an outdoor workstation. Unfortunately, these qualifications rule out only the worst part of winter.

Chapter 16

Layer XII: A Besant Hunting/Raiding Party

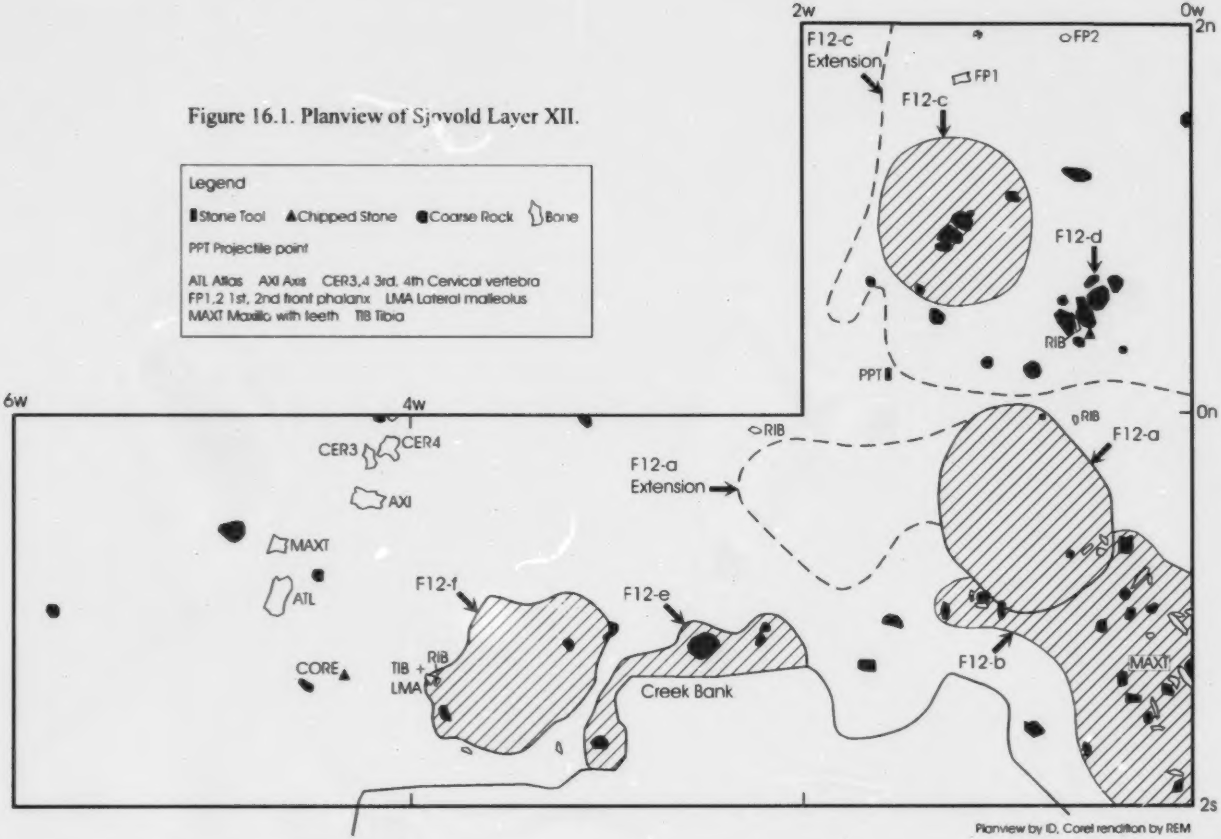
Introduction and Planview

Layer XII lies 185-192 cm BS at 2n2w and is coincident with a diffuse grey-black zone tentatively identified as buried soil Ahb8. Our 15 square meter exposure in XUs 1 and 4-6 was smaller than for previous layers and represents a transition toward a focus on XUs 4-6 which characterizes deeper excavations. We uncovered six features: three hearths and three associated hearth-drag areas. The amount of surrounding occupation debris was modest and comprised mainly of broken rock and finely broken bones. From a high point at 2n2w the layer had a gentle downward slope to the west (1:40) and south (1:40). East of 2n2w the occupation surface was level to the limit of excavations. Two segments of an infilled horizontal animal burrow were observed in the middle of XUs 4 and 5. Two vertical animal burrows were intercepted toward the center of XU 6. Animal burrowing may account for the penetration of some cultural materials beneath the layer. However, a couple of Layer XII hearths also carried debris into the interlayer. Layer XII materials which penetrated the interlayer up to a depth of 5 cm have been included in the Layer XII analysis. A radiocarbon date on a sample of bone indicates that occupation occurred between 650 and 350 BC (cal 2600-2300 BP; Table 3.6).

Between Layers XII and XIII is a deposit, 32 cm deep, containing a small quantity of cultural remains. Materials from the lower 27 cm of the interlayer are reported under the section on Interlayer XII/XIII. The upper body of Interlayer XII/XIII was comprised of about 18 cm of buff-coloured sandy silt. A little more than midway through the interlayer, between about 210-215 cm BS at 0n2w, there was a barely recognizable horizon of slightly coarser buff sand. Coincidental with this horizon was a smattering of large bones and bone fragments together with a few rocks. It is uncertain whether this is a primary or a secondary deposit, and we have not given it a separate label. Beneath that is a 15 cm thick continuation of buff silts and sands comprising the bottom of Interlayer XII/XIII.

The Layer XII planview (Fig. 16.1) shows the arrangement of six features and a relatively sparse scatter of rocks and bones. Of special interest is a row of bison neck vertebrae that probably reached the site as an articulated unit. A nearby maxilla fragment, assigned to age group 4-5, suggests that the skull may have been part of this unit but was largely destroyed by processing. A second maxilla fragment, on F12-b, contains only P^2 and has not been assigned to an age group. All other bones on this feature are fragments of long bones and ribs.

Figure 16.1. Planview of Sjovold Layer XII.


Legend
Stone Tool
Chipped Stone
Coarse Rock
Bone
PPT Projectile point
ATL Atlas AXI Axis CER3,4 3rd, 4th Cervical vertebra
FP1,2 1st, 2nd front phalanx LMA Lateral malleolus
MAXT Maxilla with teeth TIB Tibia
6w
4w
2w
0w
2n
0n
2s
F12-c Extension
F12-c
F12-d
F12-a
F12-a Extension
F12-b
F12-e
F12-f
FP1
FP2
PPT
RIB
MAXT
CER3
CER4
AXI
ATL
CORE
TIB + LMA
Creek Bank

Planview by ID, Corel rendition by REM

Table 16.1. Features in Layer XII.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F12-a	surface hearth	50s110w	170	290	2-7
F12-b	hearth drag	125s35w	140	130	0-5
F12-c	extended hearth	100n125w	>190	>190	1-8
F12-d	rock cluster	125s35w	32	35	0-6
F12-e	hearth drag	160s253w	>75	114	1-4
F12-f	surface hearth	130s345w	80	95	1-9

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

Features

Feature F12-a (Fig. 16.1, Table 16.1) was a surface hearth situated in XU 4. It had a circular central body about 75 cm in diameter. Attached to the western edge was a muted surface extension of buff, black, and grey soil about 60x100 cm. The western extension and the area around it was barren except for a couple of mid-size rock and bone fragments. The core of the hearth was comprised of two parts: (1) a 2-5 cm thick surface layer of black, brown and grey soils; and (2) an underlying 3-4 cm thick lens of brown/black/red soil. The surface layer contained a few chunks of charcoal, four pieces of chipping debris (one quartzite, two petrified peat, one Swan River Chert), 11 pieces of fired rock weighing 358 g, and several pieces of burned and unburned bone. Most of the debris was mixed into the surface layer near the margins. There was a bison rib segment projecting out of the northeast corner. A Knife River Flint dart or spear point was situated just a few cm beyond the northwest margin. About 20 cm north was another hearth, F12-c. About 45 cm northeast was a cluster of rocks, F12-d. Attached to the south and southeast margins was a surface concentration of hearth materials and other debris, F12-b. About one meter southwest of the F12-a core was a zone of hearth debris, F12-e, and just beyond that another hearth, F12-f.

We interpret the central part of F12-a, the portion underlain by brown/black/red soil, to have been the seat of the hearth. The presence of charcoal shows that at least some of its fuel was wood, and the moderate depth of underlying burned earth shows that the intensity and/or duration of burning was moderate (several hours to a few days?). The surface extension to the west is probably ash and charcoal blown by wind. The sparse amounts of stone and bone in that area support such an idea. In contrast to the western extension of F12-a, the patch of blackened soil and debris to the southeast (F12-b) is much denser. The most likely hearth-side sitting areas were bare patches to the east and southwest.

Feature F12-b was a diffuse patch of black, brown and grey soil laden with fragments of fired rock, bone and chipped stone and situated immediately southeast of F12-a. It ranged from 0-5 cm in thickness and was roughly 125 cm in width. F12-b blended with the southeast edge of F12-a at one

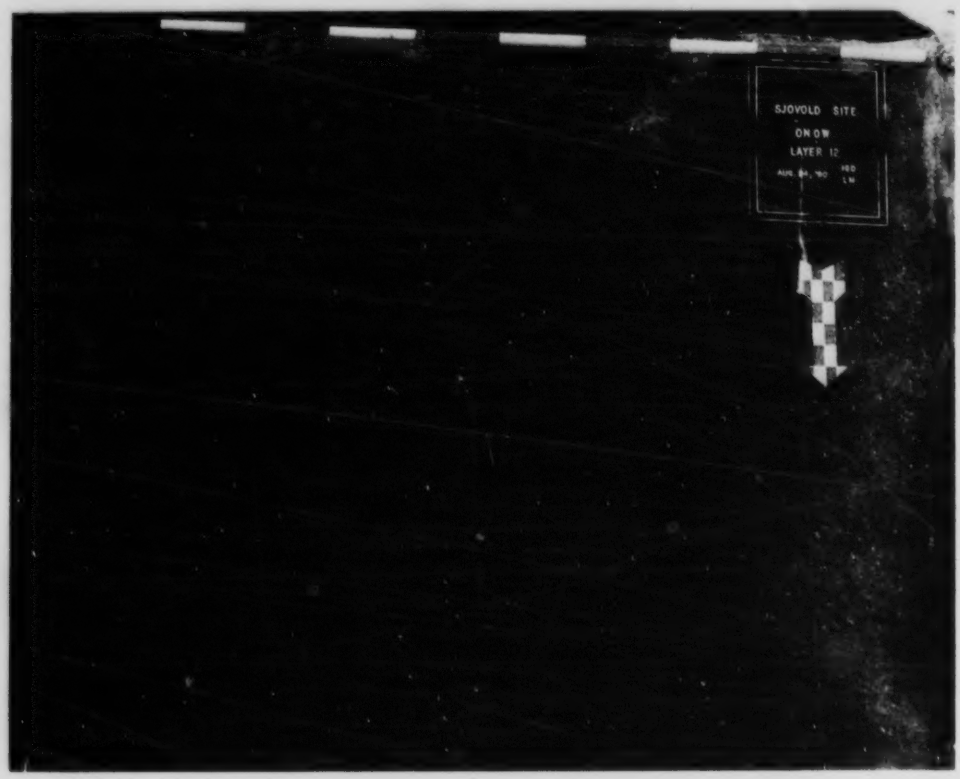


Figure 16.2. F12-d rocks (upper left) and a parallel row of rocks on the unexposed core of F12-c. RSM #EiNs-4:80-185 CT.

end and extended southeastward to the limit of excavation at the other. There was no trace of burned or oxidized soil beneath this feature. The surface soil was similar to that on the surface of hearth F12-a, but a little less black. The bone and stone debris was also similar but present in greater amounts. One might imagine that F12-b was the remains of a second hearth in which bison chips were used as fuel. That would explain the absence of the underlying lens of oxidized soil. However, one is then left to wonder why two apparently contemporary hearths would have been built side by side and fuelled by different substances. We think it more likely that F12-b was not a hearth, but rather was the residue of hearth materials which were dragged from the top of F12-a. Hence, our label "hearth drag." There could be several reasons why a substantial amount of coals and debris would be dragged off a hearth. One reason might be to spread out materials which had been buried in coals so that certain parts, such as hot rocks, could be selected for use. Another might be to make a bed of coals over which something could be dried or roasted. Yet another reason might be to disperse a fire so that it would die down more quickly. We cannot select a single explanation, but we note that each of the

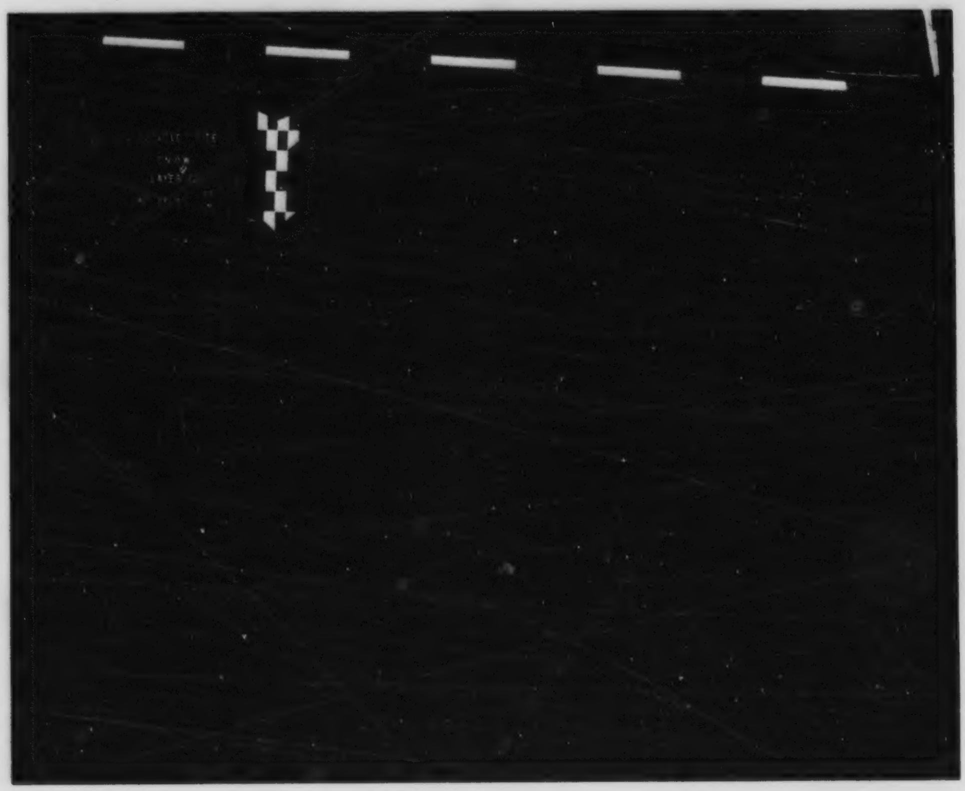


Figure 16.3. F12-c showing burned soil beneath its surface. RSM #EiNs-4:80-187 CT.

hearths exposed in Layer XII exhibits a variant of this dragging process with a tendency for the dragged material to lie southeast of the nearest hearth.

Feature 12-c was a medium-size hearth with an extended surface expression. The core of F12-c was situated 150 cm (measured center to center) north-northwest of F12-a. It was 80 cm in diameter and, like F12-a, composed of a surface layer of charcoal and ash-infused soil 2-4 cm in thickness, and a subsurface lens of brown/red soil 1-4 cm in thickness. There were fragments of fired rock, charred and calcined bones, and chipping debris (mostly Knife River Flint) on and in the surface layer. Most notable were six medium-size fragments of fired rock strung across the hearth core in a southwest to northeast row (see Figs. 16.2-16.3). The blackened soil and debris of the surface layer extended in all directions beyond the limits of the subsurface lens — up to 30 cm west, 50 cm south, at least 40 cm north to the limit of excavation, and at least 160 cm to the east and southeast again to the limit of excavation. The soil of the extended surface layer was slightly less black, but it contained the same kinds of debris as found on the core, though generally in smaller quantities. An exception was a tight cluster of fired rock about 25 cm southeast of the core which will be described as Feature F12-d. There were four stone tools associated with F12-c — three MURLs within the extended part, and a damaged dart or spear point at the edge of the southward extension. All were made of Knife River Flint.

Feature 12-d was a tight cluster of eight medium-size sooty rocks weighing about 6,600 g (see Fig. 16.2). The cluster was situated on the southeast part of the F12-c surface extension. Its center point was 75 cm southeast of the center of the F12-c core. The F12-d rocks showed degrees of disaggregation varying from fractured but quite solid to fractured and very crumbly. The cluster rested in a very black portion of the extended hearth. Among the tight spaces between the rocks were several calcined bone fragments, a rib segment and a flake of Knife River Flint. A striking attribute was that the long axis of the rock cluster had a southwest to northeast alignment which was parallel to the row of stones on the F12-c core. Our interpretation of F12-d is that it was a group of heated rocks which had been drawn off the core of the hearth, presumably to await use in a stone-boiling operation nearby. Along with the rocks came a certain amount of bone debris which had been disposed of in the hearth. The rib segment and flake may have been added once the cluster was in place. According to this interpretation, one the important functions of F12-c would have been as a place where rocks were heated. The row of rocks over the core would be a more direct reflection of that operation. The spread of charcoal and ash around F12-c seems to have been a bit broader and more continuous than that around F12-a, while the amount of bone, particularly of uncharred fragments, seems less. Aside from those differences the two hearths and their extensions seemed remarkably similar. It is surprising that the two groups would have been situated so close to one another. Yet, they do not overlap and we suspect that they were contemporary. Perhaps being close to the creek bank was of sufficient importance to tolerate some crowding. Moreover, there may have been sufficient sitting space on east and west sides of F12-a and F12-c so that crowding was not really a problem. In any case, a third pair of features, F12-e and F12-f, presents a similar activity set just a short distance to the southwest.

Feature F12-e was represented by only a 5-25 cm wide strip of its northern and western fringe. The rest of the feature had been destroyed by a combination of creek bank erosion and our excavation of test profile 2. Nevertheless, the remaining fringe gave a fair impression of what the whole feature may have been like. F12-e appears to have been a 3-4 cm thick patch of black/grey/brown soil which was at least 100 cm wide and which lay upon buff-grey soil typical of the bottom of Layer XII and the interlayer below. Within the feature's matrix was a mixture of eight medium-size to small fired rock fragments, one MURL, one Knife River Flint flake and several bone fragments. In addition there were four medium-size to large fired rocks resting on its surface. Hearth F12-f was situated only 7 cm to the NW and our guess is that F12-e was hearth drag derived from F12-f.

Feature 12-f was a medium-size surface hearth whose center was about 300 cm southwest of the centers of F12-a and F12-c. It was oval, rather than circular, and measured 100 cm along its southwest-northeast axis by 65 cm along the other axis. The surface layer of charcoal and ash-infused soil was about 1-3 cm thick. It supported three medium-size fired rock fragments, two on the fringes

Table 16.2. Coarse rock from Layer XII.

Material	XU 1	XU 4	XU 5	XU 6	Total
Number					
amphibolite	-	1	1	-	2
basalt	-	2	-	2	4
concretion	-	1	-	-	1
gneiss	11	12	2	1	26
granite	39	31	27	5	102
grano-gneiss	-	5	7	-	12
greywacke	14	-	-	-	14
limestone	1	2	-	3	6
peridotite	-	2	-	-	2
quartz	-	-	1	-	1
quartzite	2	4	12	-	18
sandstone	2	5	1	-	8
shale	5	-	1	-	6
unidentified	28	3	1	1	33
Total	102	68	53	12	235
Weight					
amphibolite	-	54	*	-	54
basalt	-	420	-	16	436
concretion	-	14	-	-	14
gneiss	260	1,387	511	34	2,192
granite	14,422	2,360	2,274	1,200	20,256
grano-gneiss	-	415	986	-	1,401
greywacke	357	-	-	-	357
limestone	*	31	-	42	73
peridotite	-	348	-	-	348
quartz	-	-	1	-	1
quartzite	1,512	95	383	-	1,990
sandstone	54	656	5	-	715
shale	1	-	*	-	1
unidentified	2,706	45	1,750	900	5,401
Total	19,312	5,825	5,910	2,192	33,239

and one about 15 cm from the edge. Within the surface layer were 13 more medium to small fired rock fragments, and a few burned bone fragments. One of the bone fragments conjoins with a fragment found in F12-e. There was no chipped stone in the F12-f hearth. There were, however, three pieces of bone at or just beyond the fringes, plus a scatter of bison vertebrae, maxillary teeth and a few pieces of coarse rock about a meter to the northwest. The surface layer of F12-f was underlain by a 3-6 cm thick lens of reddish brown earth. Thus, F12-f was very similar to the other hearths in Layer XII. It appears to have been a place where some bison bones were discarded and where rocks were heated before being dragged into F12-e.

Rock

Analysis of coarse rock from Layer XII is based on a mixture of observations: (1) on medium-size and small rocks in the collection from XUs 4-6; (2) on small rocks collected from XU 1; (3) on field observations of medium-size and large rocks from XU 1 that were discarded in the field; and (4) on field observations of two large rocks from XUs 5 and 6 that were discarded in the field.

The most common coarse rock material in Layer XII is granite at 60.9% by weight (Table 16.2). Other materials with a showing above 3% are the unidentified category (much of which is probably granite or gneiss) at 16.2%, gneiss at 6.5%, quartzite at 6.0%, and grano-gneiss at 4.2%. There are abundant sources of these materials on the creek and river beds and on the valley slopes near the site, so it is probable that the Layer XII coarse rock is derived from local sources. It appears, however, that there was a deliberate selection for granite since that material, at 60.9% of the layer sample, greatly outstrips the natural abundance of granite in local sources (36% [Dyck 1990]). Virtually all larger fragments of coarse rock in Layer XII show signs of exposure to fire, with the possible exception of the limestone and some sandstone. The average specimen weight is 141.4 g, slightly below the site average, but still quite high considering that so much of the rock has been fired. Thus, one might characterize the degree of firing of these stones as moderate and infer that neither the intensity nor the duration of use was very great.

Stone Tools

MURLs (n=3). Only one of the Layer XII MURLs is complete and the other two each represent less than half a tool (Fig. 16.4, Table 16.3). Although there is risk in extrapolating a broken MURL to its complete form, we believe that all three specimens were of the same general type, namely flakes or shatter with a naturally sharp lateral edge(s) at least part of which could be used for cutting. Catno 5629, the complete specimen, is actually part of a broken, ridged flake with one sharp, gently convex, lateral edge. That edge has a 20 mm long segment bearing very small nick and chip scars. It might be said that the scars are unifacial retouching, but it would be more correct to think of them as edge nicks biased toward the dorsal face. The tiny nicks begin about 4 mm from the proximal end and run continuously up to and then just onto a snap fracture across the distal end. A few nicks have left fresh scars, but most of the edge is slightly smoothed and quite obviously polished. Aside from a few granules of powdered charcoal there is no residue apparent on this tool. Catno 5981 is a broken flake or piece of shatter with slightly more pronounced nicking or chipping on surviving parts of both lateral edges. Here the nicks appear to be bifacial and they extend about 1 mm back from the edge. There is some smoothing and polish of the edges although they still feel sharp. A few granules of charcoal are evident on this tool as might be expected for an item found in hearth debris. There is also a trace of granular reddish material, possibly blood residue in a crease at one end. Catno 6001 is the most fragmentary specimen, being a thin spall which ran off one end of a flake tool parallel to and including part of its edge. It includes a 14 mm segment of original flake tool edge on which there is some interesting wear and residue. The edge shows a mixture of larger (up to 2 mm) and smaller nicks with a generally unifacial bias. In this case the nicked edge is well worn and slightly rounded. There is abundant fine granular reddish material on the edge, on nick scars and on adjoining parts of the most nicked face. Once again our suspicion is that the residue is blood. Our general interpretation is that the three tools are of the same type showing only different degrees of wear, with catno 5629 having been used least. If the reddish residue is blood, then cutting meat was likely one of the functions served by these little tools.

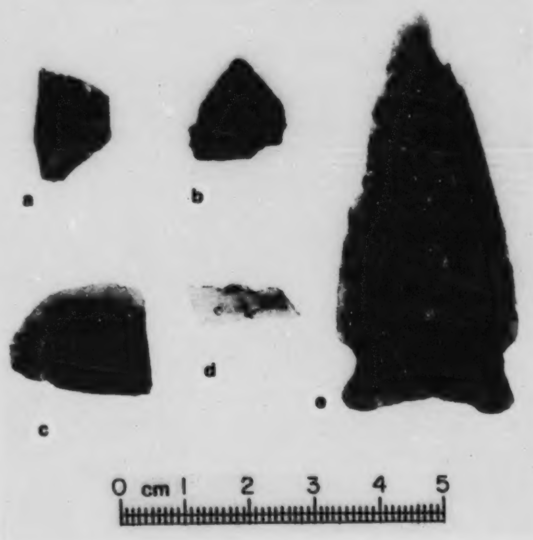


Figure 16.4. MURLs (a, c-d) and projectile points (b, e) from Layer XII.

Projectile points (n=2). Catno 5378, at more than 61 mm in length, is the largest projectile point recovered (see Fig. 16.4). It has side-notches just above its broad concave base, and long gently convex lateral edges. Part of the tip and a bit of one side are missing, having separated along a curving and "stepped" fracture emanating from the tip. The fracture exited about 16-18 mm down one side. Direct impact at the tip along the longitudinal axis of the point seems to have been responsible for the fracture. It appears that an attempt was made to retip the point. A series of flakes were removed on one face from the (remaining) tip to a little more than midway down one edge. The chipping was done on the unbroken edge. Evidently, the flintknapper encountered chipping problems in a faulted area at the center of the blade where his flakes began to step-fracture. Presumably that led to abandonment of the retipping and discard of the point. By its size one would suspect that this point was in the dart or spearpoint range. Application of the Thomas (1978) discrimination equations for arrowheads and darts yields values of C_{dart} = 25.89 and C_{arrow} = 22.46 which confirms the dart, or at least larger than arrowhead, interpretation. The notches, lateral-basal corner and the beginning of the basal edge were ground smooth, in places rounded and in other places almost flattened. Across the concavity of the basal edge the smoothing was less pronounced but still present. The lateral edges of the blade were sharp on both sides without apparent evidence of smoothing. The basal concavity began about 5 mm from either corner and, at the center, had a depth of 2.8 mm. The basal thinning flakes by which the concavity was formed ran as much as 16 mm up one face of the point, but on the other only one flake reached as far as 9 mm while the rest were mostly about 4 mm in length. Though there were traces of cream-buff calcium carbonate adhering to this specimen, there was none of the reddish granular residue which we have

Table 16.3. Stone tools from Layer XII.

Type	Catno	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
MURL	5629	1	2.4	22	17	6	Knife River Flint	y	16.4c
MURL	5981	1	0.9	12	18	5	Knife River Flint	n	16.4a
MURL	6100	1	0.1	17	6	2	Knife River Flint	n	16.4d
projectile point	5378	1	10.1	62	28	4	Knife River Flint	n	16.4e
projectile point	5491	5	0.6	15	14	2	silicified sediment	n	16.4b

seen on other specimens. Consequently, this rather well-made specimen may have been damaged without ever hitting its target.

Catno 5491 is a small fragment of shattered projectile point. All that survives is part of one notch, the mid-part of a straight basal edge, a damaged haft area, the damaged stump of the blade, and parts of two lateral edges. The notch appears to have been on the side but set close to the base. It was well ground. What survives of the basal edge was lightly ground. The neck width would have been in the order of about 14 mm; the overall length was probably less than 20 mm and the thickness about 3 mm. Thus, even as a complete specimen, catno 5491 would have been much smaller than catno 5378.

Comparisons: The large specimen, catno 5378, is similar in form and age to a type that Wettlaufer (1955) called Sandy Creek. On the basis of this similarity one of us (Dyck 1983:108-109) suggested that Wettlaufer's type be resurrected within the northern Plains cultural sequence. Two new pieces of information now lead us to modify that suggestion. The first is Ramsay's (1991) study of the Melhagen site collection. Her detailed analysis and comparison of projectile points from this Besant bison kill site shows that some very similar side-notched, basally concave points occur regularly in Besant assemblages. Moreover, such points are often made of Knife River Flint. The second piece of information was our discovery of a second projectile point in the Sjovold Layer XII assemblage, one which had a straight, rather than concave, base. This point was recognized during close analysis of the occupation debris in the course of the present study. It shows that Layer XII contained more than one form of projectile point and it casts doubt on the notion of our ability to diagnose a northern Plains complex on the basis of a single projectile point, even though it might be well formed and nearly complete. We suspect, therefore, that Layer XII at the Sjovold site belongs to what we are calling the Besant series. If so, the Layer XII date may push the age range of this group back several hundred years before the time of Christ. It may also be useful in establishing a different concept about Besant projectile point types, namely that they comprise not one type but several. With this in mind we propose that the name "Besant" be abandoned as the name of a projectile point type and taken up solely as the name of an archaeological series. One of the Besant series projectile point types, then, would be "Sandy Creek" after the side-notched basally concave type recognized by Wettlaufer in 1955. Another might be the convex-based Bratton type identified in Sjovold Layer XI. Under this scheme

Table 16.4. Chipped stone debris, excluding cores, from Layer XII.

Material	XU 1	XU 4	XU 5	XU 6	Total
Number					
chert	1	-	1	-	2
Knife River Flint	15	3	1	-	19
petrified peat	-	2	-	-	2
petrified wood	1	-	-	2	3
quartzite	-	1	1	1	3
quartz	-	1	1	-	2
Swan River Chert	3	1	-	1	5
silicified sediment	-	-	-	1	1
Total	20	8	4	5	37
Weight					
chert	2.4	-	0.7	-	3.1
Knife River Flint	11.8	2.7	1.0	-	15.5
petrified peat	-	1.5	-	-	1.5
petrified wood	1.5	-	-	2.9	4.4
quartzite	-	1.3	18.9	1.5	21.7
quartz	-	1.0	172.2	-	173.2
Swan River Chert	3.6	1.1	-	0.7	5.4
silicified sediment	-	-	-	0.3	0.3
Total	39.3	7.6	192.8	5.4	225.1

the Besant straight-based form(s) is yet to be named.

Chipped Stone Debris

Quartz provided the greatest weight of chipping material in Layer XII (Table 16.4). Its weight is 77.0% of the debitage total, excluding cores which are considered separately. Next is quartzite at 9.6% and Knife River Flint at 6.9% with other materials each having less than 3% of the total. It should be kept in mind that the sample of Layer XII chipping debris is very small and its statistics are easily skewed by inclusion of a couple of unusually large and little used pieces, as has happened with the appearance of two large pieces of quartz. One gets a better impression of the result by examining the average weights of materials. At 86.6 g per specimen the average for quartz is unusually high. Quartzite, at 7.2 g, is also high but within the range seen for quartzite in other layers, while Knife River Flint, at 0.8 g per specimen, is well within the range seen in other layers. One gains a true impression of the importance of Knife River Flint in this layer only by considering the number of specimens of each material type. Then, Knife River Flint registers at 51.4%, Swan River Chert at 13.5%, quartzite at 8.1% and quartz at 5.4%. Knife River Flint is even more dominant (80%) among the tools. Thus, even though quartz has the greatest weight, the material with the greatest numbers is most important.

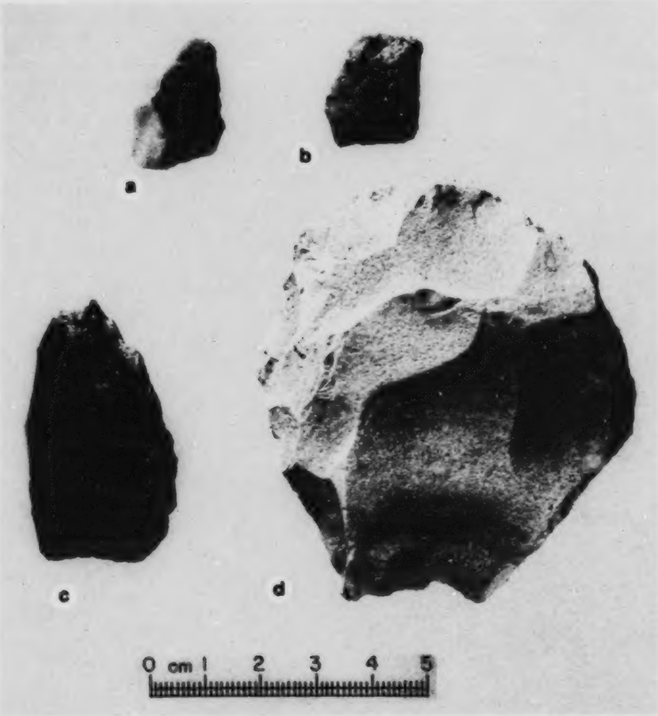


Figure 16.5. Chipped stone cores from Layer XII.

Furthermore, Knife River Flint debitage represents all stages of material reduction from decortication of raw material to fine retouch of used tools. Thus, Layer XII exemplifies a situation in which the most important chipping material is exotic, and local materials are represented mainly by coarser types (quartzite and quartz). From this we infer that either the occupants were foreign to the area and carried a supply of Knife River Flint adequate for most needs, or they were local people who had recently acquired such a good supply of Knife River Flint that they had little need to search for other chipping material. The near absence of petrified peat makes this layer stand out from many others in the site and makes us suspicious that the occupants were not of local origin.

There are four chipped stone cores in Layer XII (Fig. 16.5, Table 16.5). Three (chert, KRF and SRC) are bipolar, and one (metamorphosed sandstone) is amorphous. Catno 5460 would be classified by many archaeologists as a pièce esquillée, a tool used as a wedge or incisor (cf. MacDonald 1968; Milne-Brumley 1978; Le Blanc 1992). It is roughly square with bifacially chipped or crushed edges. One edge appears to have been broken leaving flat facets in place of a sharp edge. Le Blanc (1984, 1992) found that 374 pièces esquillées from level 5 of the Rat Indian Creek site averaged about 20 mm in length, 6.9 mm in thickness and 3 grams in weight. Catno 5460 is remarkably close to those measurements with a length of 20 mm, thickness of 7.0 mm, and weight of 2.9 g. Since repairs were being made to darts and arrows around the same hearth that contained catno 5460, it is possible that this piece was used for splitting bone or for incising antler, bone or wood needed for hafting. Although no antler was recovered from the site, a piece of deer humerus was found in the same excavation unit (XU 1) as catno 5460 together with a large broken dart point. Thus,

Table 16.5. Chipped stone cores from Layer XII.

Type	Catno	XU	Weight	Size*	Material	Fig.
amorphous	5435	6	86.2	c	sandstone	16.5d
bipolar	5460	4	2.9	a	Swan River Chert	16.5b
bipolar	5501	5	14.8	b	Knife River Flint	16.5c
bipolar	5626	1	4.9	a	chert	16.5a

* size refers to categories based on greatest length: (a) 13-25mm, (b) 26-49 mm, (c) 50-100 mm, (d) 100-149 mm, and (e) 150 mm and larger.

we do not rule out the possibility that catno 5460, though obviously qualifying as a bipolar core, may have served as a wedge or incising tool.

Faunal Remains

All four excavation units contributed bone fragments to a radiocarbon sample (S-2059). Most of the sample material came from XU 1 (204 g) and XU 5 (two ribs) to achieve a sample weight of 282 g. The remainder of the bone is shown in Table 16.6.

Bison, NISP=46: tympanic bulla, maxilla containing $M^{2\text{-}3}$ (AG 4-5), maxilla containing P^2, four mandible fragments (symphysis, lower border, coronoid process, articular condyle), three upper teeth (M^1, M^2, M^3; AG 6), M^1 (AG 10-11), three $I_?$, P_2, M_3 (AG 5?), atlas ♀/©, axis, 3rd and 4th cervical vertebrae, six rib cylinders, two humerus shafts, distal radius, metacarpal shaft, front 1st phalanx ♂, two front 2nd phalanges, femur shaft, two distal tibiae ♂ ?, four tibia shafts, two lateral malleoli ♀/© ♂, tarsal C+4 ♀/©, distal metatarsal, hind 1st phalanx ♂, unassigned 1st phalanx fragment. Maxillary dentitions from Layer XII indicate that at least three bison age groups are represented. The M^1 assigned to age group 10-11 can be refitted into a maxilla from Interlayer XII/XIII. Cranial and axial elements are unusually well represented compared to appendicular elements. From their relative sizes and locations in XU 6, it seems likely that the four cervical vertebrae entered the site as a single butchered unit, perhaps attached to a skull. Impact marks appropriate to marrow recovery are seen on humerus, metacarpal, and tibia shaft fragments. A coronoid process from feature F12-f can be refitted to an ascending ramus in feature F12-e; the former was probably broken from the latter during disarticulation of the mandible from the skull. No cut marks have been observed, and the only tooth mark is on the end of a rib. Weathering is less intensive than in Layers X and XI with only seven bones weathered to Stage 2 and ten to Stage 1. Nearly all the bones and teeth are etched by rootlets, and 16 are etched to a moderate degree.

Size 5-6 mammal, unidentified, n=31: one cranial, two tooth, one vertebra, three intervertebral disk, 13 rib, 11 long bone fragments.

Table 16.6. Vertebrate remains from Layer XII.

Size, Taxon	XU 1	XU 4	XU 5	XU 6	Total
Number					
6, Bison	6	12	19	9	46
5-6, mammal	-	15	10	6	31
5, Deer	1	-	-	-	1
4-5, mammal	-	-	2	-	2
-, mammal	11	172	106	45	334
Total	18	199	137	60	414
Weight					
6, Bison	193.4	340.2	997.3	953.6	2,484.5
5-6, mammal	-	180.8	79.8	27.8	288.4
5, Deer	15.9	-	-	-	15.9
4-5, mammal	-	-	4.3	-	4.3
-, mammal	2.7	146.3	64.2	33.4	246.6
Total	212.0	667.3	1,145.6	1,014.8	3,039.7

Deer, NISP=1: humerus shaft. This bone is fresh-fractured, marked by tooth punctures and rotational scarring, weathered to Stage 1, and superficially etched by rootlets.

Size 4-5 mammal, unidentified, n=2: lumbar vertebral arch, rib fragment. These elements might represent a small deer or a large canid.

Unidentified mammal, n=334: fragments of which only 15 (4-8 cm) are larger than 4 cm long. Most of the 61 charred and 29 calcined specimens are from XU 5 where they were associated with a hearth (F12-f) and nearby hearth drag (F12-e).

Plant remains: One charcoal sample (11 pieces, 3.8 g) was collected from F12-a.

Discussion: Portions of the three bison represented among Layer XII bones and teeth appear to have formed the subsistence base, but the role of the deer is not clear. This solitary element is so heavily marked by carnivore gnawing, in contrast to the bison bone, that it may have been introduced to the site by a scavenger.

Interpretation of Layer XII

Our exposure of Layer XII revealed three surface hearths, each with an associated concentration of hearth and occupation debris at its southeast corner. The hearths were arranged so that two were close to the (modern) creek bank and about 2.5 m apart. The third was set back about

Table 16.7. Modified vertebrate remains from Layer XII.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	-	-	1	-	17	45	9	2	13	12	10	46
5-6, mammal	-	-	-	-	*	*	2	3	6	20	-	31
5, Deer	-	-	1	-	1	1	-	-	-	1	-	1
4-5, mammal	-	-	-	-	-	1	-	1	1	-	-	2
-, mammal	-	90	-	-	*	*	-	*	*	*	-	334

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

3 m back from the creek bank, lying about 1.5 m north-northwest of one of the creek-edge hearths and about 3 m north-northeast of the other. Thus, the three hearths made a fairly tight grouping. There was not a great deal of occupation debris on any of the hearths, but there was enough to show that they had been used for heating rocks, that wood had been used as fuel, and that some broken bones and chipped stone debris had been discarded into them. There was, however, a denser concentration of the same materials amidst a thin surface layer of charcoal and ash-infused soil immediately to the southeast of each hearth. While the hearths were underlain by lenses of burned soil, the associated concentrations were only surface patches of debris with no underlying signs of burning.

A cluster of fired rocks, F12-d, was the most prominent feature of the debris associated with the southeast corner of hearth F12-c. It is interpreted as being a charge of rocks which had been dragged off the hearth and assembled in one place for use as boiling stones. There were also a few cutting tools, a possible wedge or incising tool, a broken dart point, stone chipping debris and bone fragments in or on the fringes of this concentration of hearth-dragged material. These indicate that dart point repair and replacement, meat cutting, and bone breaking, possibly for marrow consumption, took place nearby. The residue of those activities was discarded both in the hearth and hearth drag areas. The other hearth and hearth drag pairs present slight variations of the same general suite of activities. F12-b and F12-e drag areas contained no tools and one shattered projectile, respectively, but each was only partly exposed by our excavations.

The three hearth and drag areas occupied much of the excavated area. The occupation surface that was not covered by these features was either bare or sparsely covered with bone, coarse rock and chipped stone debris. Amongst such spaces was room for one or two people to sit at each of several places — east of hearth F12-a, southwest of F12-a, north, northwest and south of F12-f. There was insufficient exposure of the occupation surface around F12-c to see where its users might have sat. One additional bit of information about layout concerns some larger bones and stones situated about 0.75 m northwest of F12-f. There were a few bison vertebrae, maxillary teeth and coarse rocks lying on bare ground roughly in a line parallel to the long axis of the hearth. When one looks at this line of debris, the F12-f hearth, its hearth drag as a group, once again one notices a southwest to northeast orientation.

A possible explanation for the southwest to northeast orientation of features is that the arrangement was influenced by wind direction. Modern records (AES 1982) show that prevailing winds in the Outlook area are from the southeast (22% of the time) and the northwest (21% of the time) during April through October, the seasonal period for which Layer XII occupation is suspected. During fieldwork at the site we found that we were sheltered from most winds — by trees immediately to the east and west, by valley walls to the north, and by a combination of trees and valley walls to the south. The only direction from which winds could penetrate directly was southeast. Southeast winds were free to sweep across the river, up the creek, and onto the site. By the presence of wood charcoal in the hearths it would seem likely that trees were present around the site during the Layer XII occupation and that sheltering conditions may have been similar to those of today. Accordingly, if the wind had been blowing from the southeast, then the area immediately northwest of any Layer XII hearth would have been rendered uncomfortable by smoke and heat. A northwestern position would have been one of the worst places to drag hearth materials for a better view of the contents. The best direction, considering the apparent need for more than one hearth in this confined area, would have been to the southeast. In that position any additional smoke or heat coming from dragged materials would simply have joined the existing stream of smoke from the hearth, neither widening it nor impinging upon smoke-free space needed by other campers. Thus, we believe that the hypothesized presence of a southeast wind provides a fairly compelling explanation for the orientation of the Layer XII features. Such an explanation implies that the occupation occurred out-of-doors in fair weather.

The presence of three hearths in close quarters is also a curiosity. Since all three were resting on the same occupation surface without overlapping, we believe that they were contemporaneous with one another. Their parallel orientations give further support to the idea of contemporaneity. If they were used at the same time, then one wonders why almost exactly the same activities would have been carried out around three hearths in such close proximity. The logical answer is that one hearth was not sufficient for the job. If the group was larger than just a few people and cooking needs exceeded the capacity of a single hearth, then several hearths make sense. The clustering near the creek bank may have taken advantage of supplies of water and boiling stones, or of the wind to fan the fires.

Subsistence at this camp appears to have been based on three bison, possibly one adult bull, one cow or calf and one subadult male. Whether a single carnivore-gnawed deer bone played any part in the human subsistence is not clear. It is clear that most of bones from the three bison carcasses are missing from our sample. Yet, all major regions of bison anatomy are represented to some extent. It is possible that all parts of each bison carcass were brought into camp but that consumption and disposal of the bones was mainly at some distance from the hearths. Alternatively, different parts could have been brought from different animals depending on sex and condition. With this small sample we are left with more questions than answers.

The recoveries from Layer XII yield evidence about a couple of aspects of the occupants' identity. For one thing, the tools — projectile points, small cutting tools, presumably used on meat, and a possible wedge or incising tool — are consistent with the notion that group gender was entirely male. Hide working tools, the hallmark of women's activities, were not present. Of course, this evidence is merely suggestive of male-only presence. Another aspect of identity is the region to which the occupants belonged. Projectile point types, to be considered momentarily, certainly are consistent with a northern Plains origin for the group. However, the chipping materials used in Layer XII are predominantly Knife River Flint, a material whose sources are about 600 km to the southeast of the Sjovold site. Once again the evidence is not conclusive that occupants of Layer XII actually brought these materials to the Sjovold site from North Dakota. They could have been acquired in trade. Nevertheless, the near absence of all but the most obvious local materials implies that the occupants were foreign to the area. Moreover, the idea that a group of men from the Middle Missouri area, could have come this far north, following the protective ravines and ridges of the Missouri Coteau, while hunting buffalo and/or raiding enemies, is well within the range of documented behaviour for northern Plains peoples (cf. Masson 1890:28-34; Wood and Thiessen 1985a:166-169, 1985b:242-243; and Historical Setting, Chapter 1).

Another aspect of identity is more strictly classificatory. We propose that the concave-based projectile point found in Layer XII belongs to a type that we identify as Sandy Creek. We prefer to leave the straight-based point from Layer XII unidentified because it is so badly shattered, but it is noteworthy that different types (and sizes) of projectile points occur within the same occupation. One of us (Dyck 1983:108-109) has previously suggested that Wettlaufer's (1955) Sandy Creek culture be resurrected in the northern Plains culture-historical sequence to take account of such occurrences as the concave-based point in Layer XII. However, as the evidence from the Sjovold site unfolds we are beginning to question ever more strongly the idea that an archaeological complex, much less the looser series grouping, can be defined by a single point type. Consequently, we would not now advocate that the Layer XII be identified as a Sandy Creek component. Rather, we suspect that Sandy Creek is simply one of the projectile point types commonly found in the Besant series. This line of thinking allows us to distinguish a range of projectile point types now lumped under a single type and to begin to recognize that they show up in varying proportions at different times and places, not only within Besant but, for some types, within other entities as well. There is one radiocarbon date for Layer XII which, together with bracketing dates from layers above and below, provides a basis for estimating that occupation occurred between 650 and 350 BC (cal 2600-2300 BP; Table 3.6).

Interlayer XII/XIII

This interlayer deposit was isolated only in XUs 4-6; excavation in XU 1 ended at Layer XII.

Rock: Coarse rock from Interlayer XII/XIII includes 89 pieces weighing 2.8 kg (Table 16.8). The large size of several specimens reflects the presence of a separate horizon about the middle of the

Table 16.8. Coarse rock from Interlayer XII/XIII.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
basalt	1	1	-	2	185	755	-	940
diabase	1	-	-	1	824	-	-	824
gneiss	1	1	-	2	26	35	-	61
granite	31	10	4	45	243	442	12	697
grano-gneiss	-	1	-	1	-	13	-	13
limestone	-	7	1	8	-	36	1	37
quartz	-	1	-	1	-	3	-	3
quartzite	-	4	-	4	-	66	-	66
sandstone	1	1	-	2	75	5	-	80
silicified sediment	3	-	-	3	1	-	-	1
unidentified	7	11	2	20	40	31	7	78
Total	45	37	7	89	1,394	1,386	20	2,800

Table 16.9. Stone tools from Interlayer XII/XIII.

Type	Catno	XU	Weight	Length	Width	Thickness	Material	Whole
MURL	5549	6	5.2	27	26	9	silicified sediment	n
MURL	5560	4	2.8	18	24	13	chert	n

Table 16.10. Chipped stone debris from Interlayer XII/XIII.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
chert	-	-	2	2	-	-	1.9	1.9
Knife River Flint	1	-	-	1	0.2	-	-	0.2
petrified peat	5	-	2	7	7.9	-	1.2	9.1
quartzite	-	1	1	2	-	2.1	0.6	2.7
quartz	1	1	-	2	5.3	5.5	-	10.8
Swan River Chert	2	-	1	3	0.9	-	0.0	0.9
Total	9	2	6	17	14.3	7.6	3.7	25.6

interlayer. Materials are similar to those in Layer XII above and Layer XIII below.

Stone Tools (Table 16.9): MURLs (n=2). Catno 5549 is an edge fragment of a shattered and heat-crazed object. There is a grainy cream-coloured residue, presumably calcium carbonate, over parts of the face. Minute fragments of charcoal are also embedded in some crevices. It is difficult to

Table 16.11. Vertebrate remains from Interlayer XII/XIII.[a]

Size, Taxon	Number XU 4	XU 5	XU 6	Total	Weight XU 4	XU 5	XU 6	Total
6, Bison	6	7	6	19	476.9	271.5	826.5	1,574.9
5-6, mammal	4	5	3	12	14.1	52.4	35.8	102.3
2, Ground Squirrel	-	-	*3	3	-	-	0.4	0.4
1, Least Chipmunk	1	-	-	1	0.1	-	-	0.1
1, Jumping Mouse	-	-	*1	1	-	-	0.1	0.1
-, mammal	88	42	28	158	38.8	33.7	12.9	85.4
Total	99	54	41	194	529.9	357.6	875.7	1,763.2

a. Superscripts (*) signify that these elements are believed to be intrusive into this interlayer.

Table 16.12. Modified vertebrate remains from Layer XII/XIII.[a]

Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Fracture States Recent	Dry	Fresh	Whole	Total
6, Bison	-	-	1	-	3	19	3	-	7	4	5	19
5-6, mammal	-	-	1	-	*	*	-	-	1	11	-	12
2, Ground squirrel	-	-	-	-	-	-	-	-	-	1	2	3
1, Least chipmunk	-	-	-	-	-	-	-	-	1	-	-	1
1, Jumping mouse	-	-	-	-	-	-	-	-	-	-	1	1
-, mammal	-	6	-	2	*	*	-	*	*	*	-	158

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

guess the form of the parent piece — perhaps a biface knife or a core. Catno 5560, also an edge fragment of a larger object, may be part of a bifacial knife. The edge is bifacially retouched, worn and slightly crushed. There is reddish residue on the edge and on both faces up to 4 mm from the edge. There are also minute pieces of charcoal adhering to both faces. Catno 5549 was recovered between 5-18 cm from the top of the interlayer while catno 5560 was recorded only as belonging within the 5-32 cm zone. It seems likely that both were part of the mid-interlayer horizon.

Chipped Stone Debris (Table 16.10): There were 17 pieces of chipped stone debris (no cores) in Interlayer XII/XIII. The increased use of petrified peat marks a difference from materials in Layer XIII.

Faunal Remains (Tables 16.11-16.12):

Bison, NISP=19: maxilla containing M^{2-3} (AG 10-11), maxilla containing P^{2}-M^{1} (AG 3-4), jugal, mandibular symphysis containing C_1, articular condyle, two $I_?$, M_1 (AG 6-7), cervical vertebra, two scapula blades, two distal humeri ♀/© ♀/©, R carpal 2+3 ♀/©, R metacarpal ♂, front 1st phalanx ♂, distal femur ©, hind 1st phalanx ♀/©, unassigned 2nd phalanx. The maxilla in age group 10-11 receives an isolated M^1 from Layer XII. The other maxilla, in age group 3-4, is younger than any of the bison in Layer XII. The lower molar, assigned to age group 6-7, might belong with the group 6 maxilla in Layer XII. One distal humerus and the distal femur have been gnawed by a carnivore. Of three weathered bones, one has reached Stage 2.

Size 5-6 mammal, unidentified, n=12: one maxilla, five rib, six long bone shaft fragments.

Ground Squirrel, NISP=3: 2 thoracic vertebrae, distal ulna. All three elements exhibit a distinctive light tan stain and are believed to be intrusive into Layer XII. The ulna has been greatly enlarged by an infection at its distal end.

Least Chipmunk, NISP=1: cranium with all alveoli and containing LP^4, LM^3, RI^1, and RM^3.

Jumping Mouse, NISP=1: tibia. A distinctive yellow-brown stain and lack of rootlet etching suggest that this element is intrusive into Layer XII.

Unidentified mammal, n=158: fragments smaller than 6 cm in length.

Plant remains: One charcoal sample (4 pieces, 3.3 g) was collected from XU 4.

Discussion: Refitting of a Layer XII molar into a maxilla from this interlayer is a clear indication that some of this material belongs in Layer XII. However, the group 3-4 maxilla adds a younger bison in an age group that may be represented by a lower molar in Layer XIII (see below). Otherwise all this material could be added to Layer XII without significantly altering our interpretation.

Interpretation of Interlayer XII/XIII

This small sample may include a trace of materials from Layer XII introduced by trampling or rodent burrowing. There is a possibility that it contains materials from a separate occupation situated about the middle of the interlayer. We suspect, but cannot confirm, that the two tools from the interlayer belonged to that zone. If so, then the presence of charcoal residue on the surfaces of the tools might indicate that the mid-interlayer debris belonged to a primary rather than a secondary deposit. Some of the material from the interlayer may have been skimmed from the top of Layer XIII.

Chapter 17

Layer XIII: Earlier Hunting/Raiding Parties

Introduction and Planview

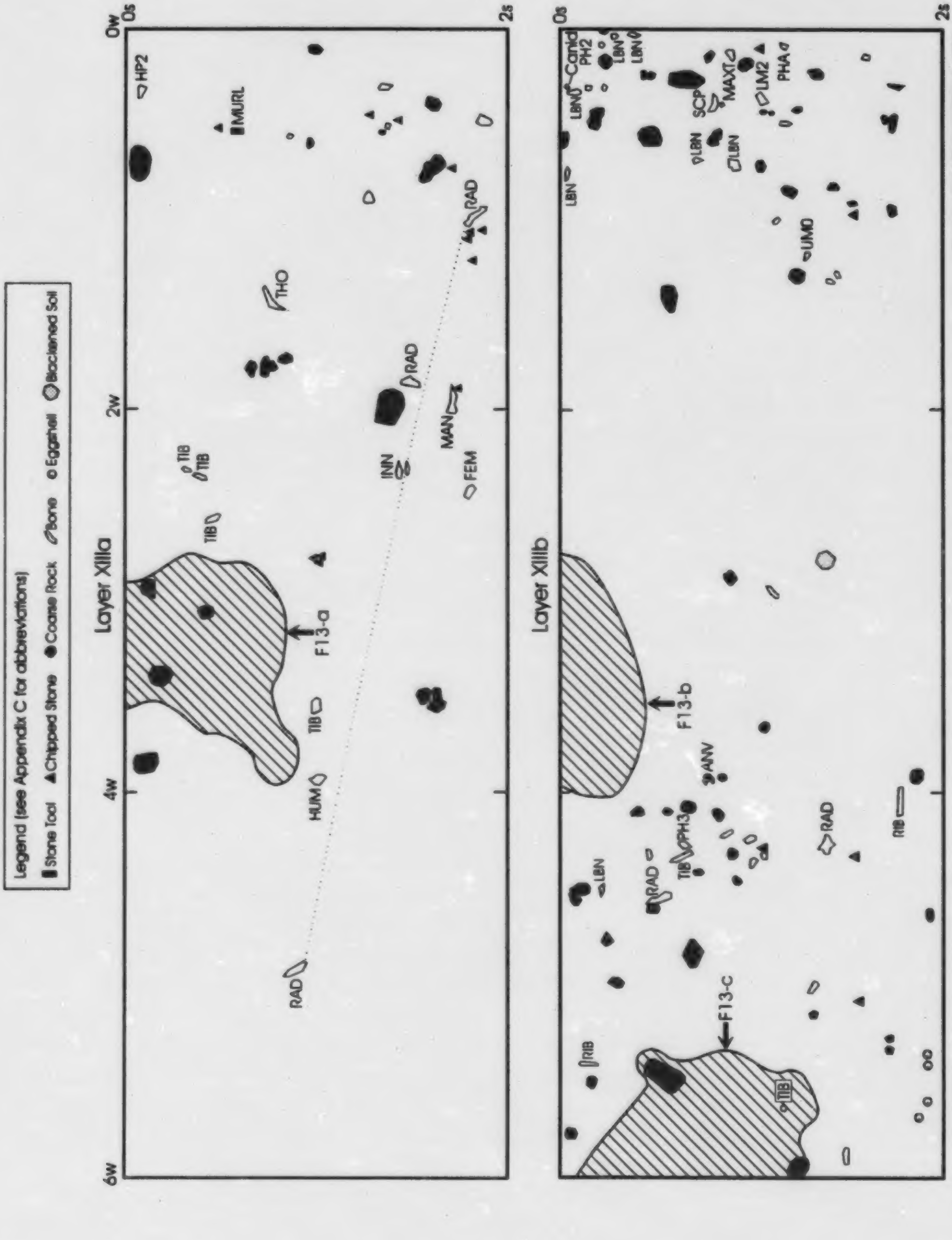
Layer XIII includes two sublayers. Sublayer XIIIa lies 224-230 cm BS at 0n2w, and our exposure of it produced one hearth and a bit of scattered debris whose cultural affiliation is unknown. Sublayer XIIIb begins at 235 cm BS and continues to about 240 cm BS at 0n2w. It contained two hearths and a slightly greater amount of debris including a crude unclassified side-notched projectile point. We can separate some of the remains by sublayer according to depth readings on planviews. Unfortunately, we did not have a firm understanding of the dual nature of Layer XIII until we completed its excavation and saw the critical profiles. Consequently, many smaller items not individually plotted by depth are now of ambiguous provenience with respect to sublayer. Therefore, although we report features by sublayer, all artifactual data are combined into a single presentation. XIIIb was nearly flat, with gentle downward slopes toward the west and south from a high point at 0n0.75w, and with slight hollows on the surface near the high point. A small amount of animal burrowing was evident, particularly in XU 6. Age of the layer is interpolated to be between 750 and 450 BC (cal 2700-2400 BP; Table 3.6).

Interlayer XIII/XIV coincides with a 12 cm thick zone of cross-bedded medium-grained sands. It contained artifacts from the bottoms of XIIIb hearths, from the top of XIVa, and possibly from animal burrows traversing Layers XIII and/or XIV. Interlayer deposits from XU 6 and the lower half of XU 5 were discarded unscreened.

Separate planviews are provided for sublayers XIIIa and XIIIb (Fig. 17.1). XIIIa yielded a rather sparse scatter of debris mainly east of the only feature. The debris includes one MURL, a few chipped stone flakes, and a variety of bison bones representing mainly the major long bones from both front and hind limbs. Two fragments of a radius can be conjoined across a distance of about 2 m. The planview for XIIIb shows two main concentrations. The western one consists of a scatter of debris between two hearth features, including an anvil, a few bison limb bones, and a scatter of eggshell fragments. The eastern concentration may mark the vicinity of a feature positioned just beyond the excavation limits. In addition to unidentified size 5-6 mammal long bone fragments there are several bison cranial elements (maxilla, upper and lower teeth) and a single canid (wolf, dog or coyote) bone.

Features

Feature F13-a (Figs. 17.1-17.2, Table 17.1), the only feature identified in sublayer XIIIa, was a shallow hearth. Its surface zone, patchy grey ash on a bed of charcoal chunks and powder, was


Legend (see Appendix C for abbreviations)
Stone Tool
Chipped Stone
Coarse Rock
Bone
Eggshell
Blackened Soil
Layer XIIIa
Layer XIIIb
0w
2w
4w
6w
0s
2s
F13-a
F13-b
F13-c
HP2
MURL
THO
RAD
TIB
INN
MAN
FEM
HUM
LBN
Canid
PH2
SCP
MAXI
LM2
PHA
UMO
ANV
PH3
RIB

Planviews by D. Corel rendition by REM

Figure 17.1. Planviews of Sjovold Layer XIII.

Figure 17.2. Overhead view of hearth F13-a. RSM #EiNs-4:80-202 CT.

Table 17.1. Features in Layer XIII.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F13-a	surface hearth	45s322w	>90	115	1-6
F13-b	surface hearth	5s335w	>50	125	1-12
F13-c	surface hearth	75s590w	115	>68	1-15

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

about 1-2 cm in thickness and slightly dished at center. There were three medium-size fragments of fired rock on this hearth, one near the center and two toward the edges. Underlying the surface was a 3-4 cm thick lens of blackened soil. A sparse scattering of rock, bone fragments and chipped stone debris began about 20 cm from the margins of the hearth and extended at least 1 m south and 3 m east. Very little debris was noticed to the west. F13-a appears to have been used for rock heating, presumably in support of a nearby stone-boiling operation where bison(?) parts were cooked and consumed. The fuel was wood, yet the underlying lens of blackened earth was unusually shallow for such a fuel. We infer, therefore, that F13-a was used only a short time.

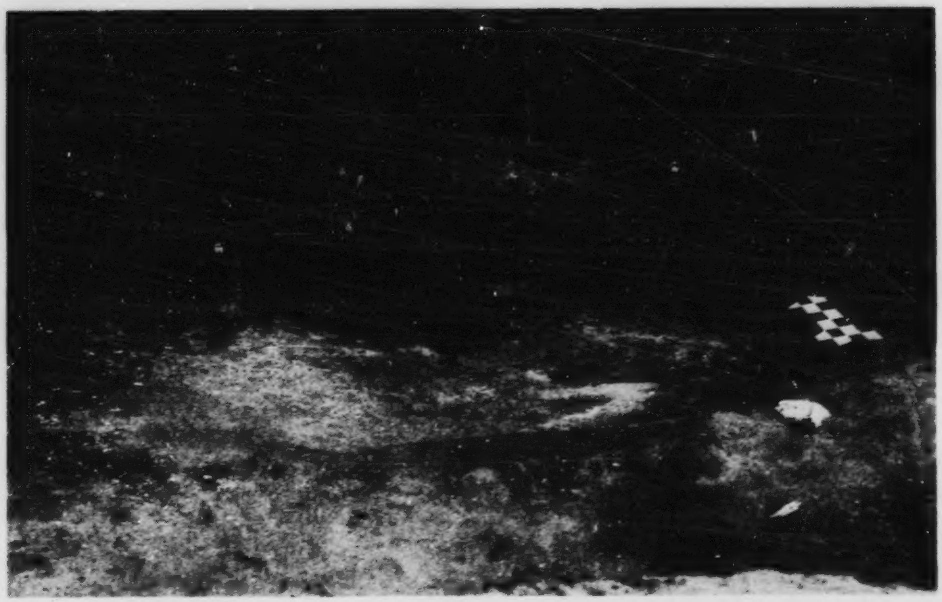


Figure 17.3. Profile view showing F13-a superimposed on F13-b. RSM #EiNs-4:80-210 CT.

Feature F13-b was one of two substantial surface hearths uncovered in sublayer XIIIb. Situated at the north edge of XU 5, about one half of F13-b was exposed by our excavations. The top of F13-b was only 2-3 cm below the bottom of F13-a (see Fig. 17.3). Center points of the two hearths were also only slightly different. The surface layer of F13-b was about 3-4 cm thick and consisted of ash, powdered and chunky charcoal, charcoal and ash-infused soil, several fragments of fired rock, a few pieces of chipped stone debris and a few fragments of bone and (bison) teeth. Underlying the surface layer was a 3-4 cm thick lens of blackened soil. Immediately below that was a 5-6 cm thick lens of reddened soil. Altogether the three superimposed parts had a maximum depth, at center, of about 12-13 cm. In making a section pit through F13-a we accidently destroyed the south margin of F13-b, so our reconstructed planview (Fig. 17.1) must be regarded as speculative in that area. There was a patch of ash-infused soil about 1-2 cm thick and more than 1 m north-south by 0.5 m east-west adjoining F13-b on its southwest edge. This ash was at a level equivalent to the upper surface of the hearth. Immediately underlying was an open cluster of fired rock fragments and broken bones resting in buff-grey soil containing small scattered chunks of charcoal. The ash thinned out about 50 cm southwest of F13-b, but grey-buff soil with charcoal and the odd piece of rock and bone continued another meter southwest to a second hearth, F13-c. South and southeast of F13-b, the occupation layer was buff-grey and contained little but the odd piece of rock and bone, and a couple of small clusters of chunky charcoal. However, about 1.75 m east and southeast there was a scattering of large, medium and small rocks, bone fragments and several stone tools, all resting on an olive-buff soil speckled with charcoal,

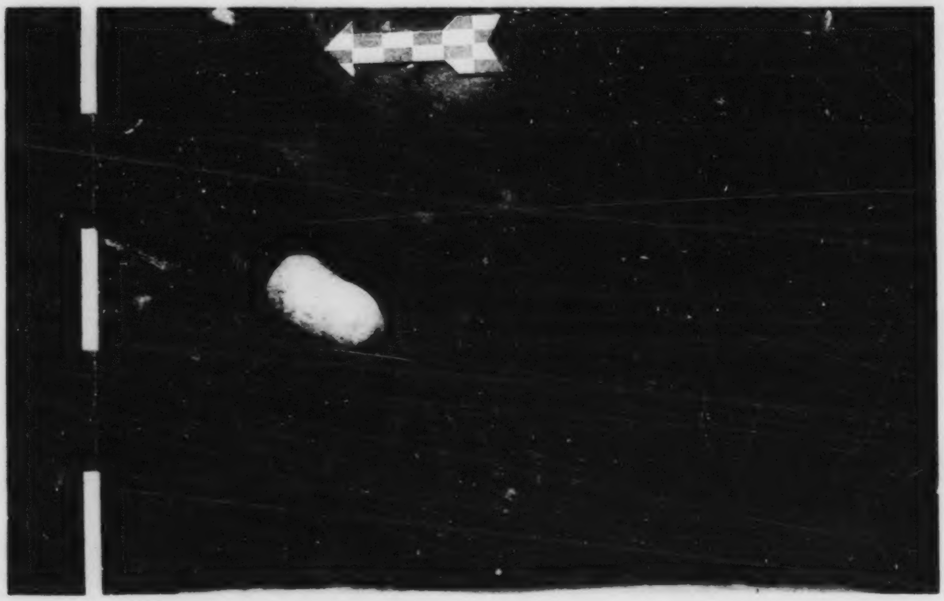


Figure 17.4. Overhead view of hearth F13-c. RSM #EiNs-4:80-213 CT.

ash and tiny shreds of grey-buff soil. This material lay in a hollow whose bottom was about 5-7 cm lower than the rest of the occupation surface.

Our interpretation of F13-b is that it was a wood-fuelled hearth which generated a lot of heat for a considerable time. It appears to have been used for rock heating and, to a minor degree, as a disposal area for bone and chipped stone trash. The patch of ash underlain by rock and bone fragments immediately to the southwest may have been hearth drag where materials were drawn off the hearth for hot stone selection, or for roasting, drying or smoking something. It appears that burial of sublayer XIIIb was fairly rapid since a good deal of surface ash was preserved on and near F13-b.

Feature F13-c, another surface hearth, was situated 1.5 m southwest of F13-b at the west edge of XU 6. We exposed approximately one half of the feature. The hearth had three parts. A surface layer, about 4-5 cm in thickness, consisted of powered charcoal and small chunks of charcoal, with a substantial patch of ash at center and less ash toward the margins. Resting on the northeast corner was a large (2,500 g) cobble (see Fig. 17.4). On the south margin was a single medium-size fragment of fired rock. Within the surface layer were 20 small fragments of fired rock (14 granite, six unidentified) weighing 107.4 g, a projectile point, 26 pieces of chipping debris — petrified peat, petrified wood, brown chalcedony, obsidian and Knife River Flint — together with a few pieces of charred or calcined bone and tooth enamel. Immediately below was a lens of black/brown soil about

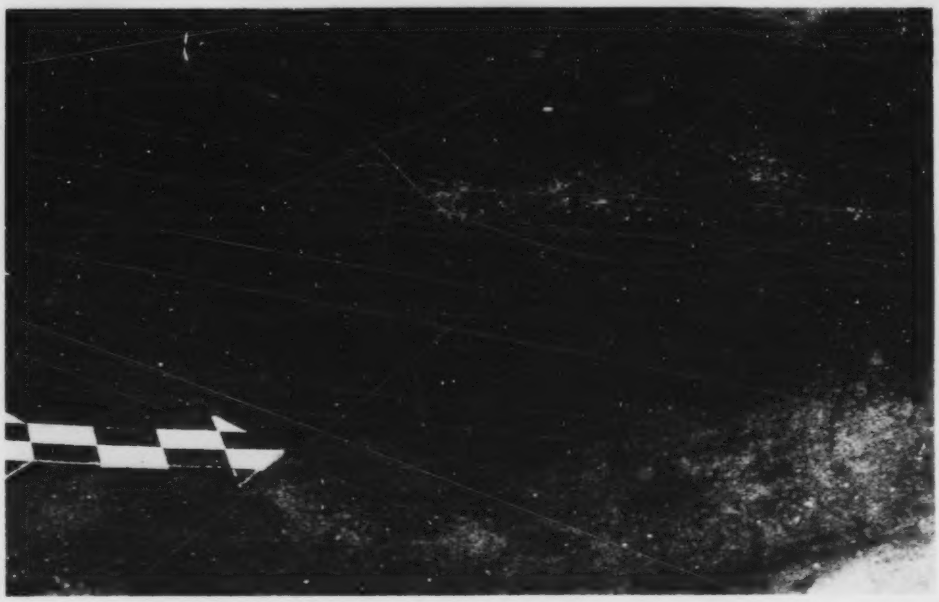


Figure 17.5. Profile view of deeply burned soil beneath the surface of F13-c.
RSM #EiNs-4:80-216 CT.

5-7 cm in thickness (see Fig. 17.5). It contained no artifacts. Below that was a 4-5 cm thick lens of rusty red soil indicating the extent of heat penetration from the hearth above. The total thickness of the feature at center was 15 cm. A thin scatter of broken bones and stones extended southeast and especially east between F13-c and F13-b. Amongst that debris were flecks and "patches" of charcoal, and numerous white spots, apparently calcium carbonate precipitate, all on a grey-buff soil.

F13-c and F13-b were similar hearths. They were about the same size, although F13-c was thicker and therefore had been subject to more extended or more intense heating. Both appear to have served as rock heating sites. F13-c was also a minor disposal area for stone chipping and bone breaking residues. The large cobble on the northeast corner arouses our curiosity. It lay within the fire since charcoal and ash-infused soil extended around it. Yet, the cobble seems too big for easy use in stone-boiling. Indeed, its wholeness is a sign that the stone had not been heated sufficiently to initiate disaggregation. There was no sign of pitting or incising on the top and no concentration of broken bone or chipped stone around the bottom, so use as an anvil seems unlikely. Perhaps the cobble served as a platform upon which something was roasted. From the amount of ash and charcoal on the surface of F13-c, we infer gentle burial shortly after abandonment.

Table 17.2. Coarse rock from Layer XIII.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
amphibolite	-	4	-	4	-	519	-	519
andesite	-	1	-	1	-	69	-	69
basalt	1	4	11	16	7	409	865	1,281
chert	-	1	-	1	-	445	-	445
gneiss	6	19	11	36	1,135	989	1,737	3,861
granite	83	87	72	242	5,881	2,510	506	8,897
grano-gneiss	-	15	37	52	-	255	884	1,139
limestone	5	17	43	65	60	185	51	296
peridotite	1	-	-	1	760	-	-	760
quartz	-	1	-	1	-	117	-	117
quartzite	14	35	14	63	624	707	313	1,644
sandstone	-	13	13	26	-	65	451	516
silicified sediment	2	1	-	3	14	1	-	15
syenite	1	-	-	1	62	-	-	62
unidentified	35	64	11	110	4,231	1,180	2,552	7,963
Total	148	262	212	622	12,774	7,451	7,359	27,584

Rock

Table 17.2 represents a mixture of coarse rock from the two sublayers. Hence, calculation of average weights and percentages by type is of little use. Five large rocks from sublayer XIIIa were discarded in the field after planview drawings were made. Estimates for their weights are included in the coarse rock figures under "unidentified." Given these qualifications, we note that a very high percentage of the coarse rock shows the indications of intensive firing — disaggregation into angular chunks or grains, crazing, cracking and colour changes. The only exceptions are basalt and limestone which may have been natural parts of the site deposits or, more likely, were brought to the site for use as *ad hoc* hammerstones and anvils. Granite and gneiss are predominant among the identified types, probably reflecting suitability for firing and local abundance. Representation of rock types is similar to that in local surface sources (cf. Dyck 1990). Distribution favours XUs 5 and 6, as might be expected, since those units contained hearths. There is, however, a notable concentration of coarse rock in XU 4 which reinforces the idea that an unrecognized feature may lie in that vicinity.

Stone Tools

Anvil (n=1). Catno 5669, a flattish cobble of andesite (Fig. 17.6, Table 17.3), provided a solid surface against which hard sharp objects could be fractured. The cobble was situated in sublayer XIIIb, about 25 cm southwest of F13-b, on the east edge of a cluster of debris between F13-b and F13-c. One

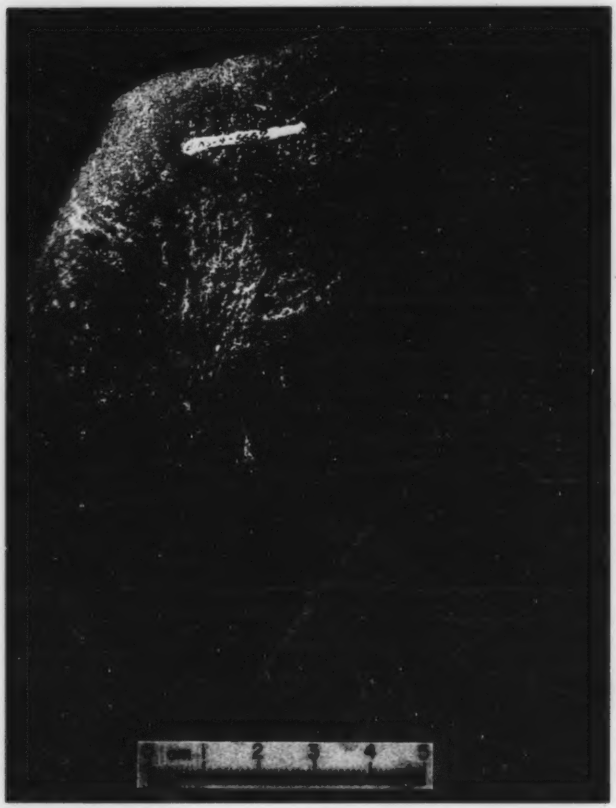


Figure 17.6. Anvil from Layer XIII.

face, originally boulder cortex, is smooth and slightly domed. The opposite face is an undulating, smoothed-over remnant of the fracture surface along which the piece was detached from its parent rock. The domed face served as the upper or working aspect of the anvil, while the undulating surface served as the base. At the center of the working face is a series of at least four parallel incisions each about 25 mm long by 1-2 mm wide by 1 mm deep. The incisions touch one another. Adjoining one end is another group of 2-3 shorter incisions oriented about 60° off the alignment of the first group. Together, the incisions occupy an area of 6-7 cm^2 at the center of the anvil. About 12 mm away is another area of shorter and shallower parallel incisions. Finally, there are 3-4 individual and randomly oriented incisions in yet another area about 10 mm from the central group. We infer that catno 5669 was used as an anvil for stone chipping; moreover, that something like the base of a bipolar core, struck upon it, was responsible for the incisions. The greatest amount of chipped stone debris in our exposure was recovered around this piece.

MURL (n=1). Catno 5653, apparently from sublayer XIIIa, is a medium-size bifacial thinning flake with fine unifacial retouching along its right lateral edge. That edge is crushed and polished. The left lateral edge appears to have been similarly retouched and used. The majority of the tool, excepting one short retouched segment, has been broken off. There is no visible sign of blood residue. Our inference is that catno 565_ was used for cutting a pliable substance such as sinew or hide.

Table 17.3. Stone tools from Layer XIII.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
anvil	5669	5	689.2	110	102	44	andesite	y	17.6
MURL	5653	4	0.8	21	14	2	Knife River Flint	y	17.7d
projectile point	5832	5	0.2	10	13	2	chert	n	17.7b
projectile point	5798	6	1.2	24	13	4	petrified wood	n	17.7c
projectile point	5900	6	0.5	19	12	2	Knife River Flint	n	17.7a

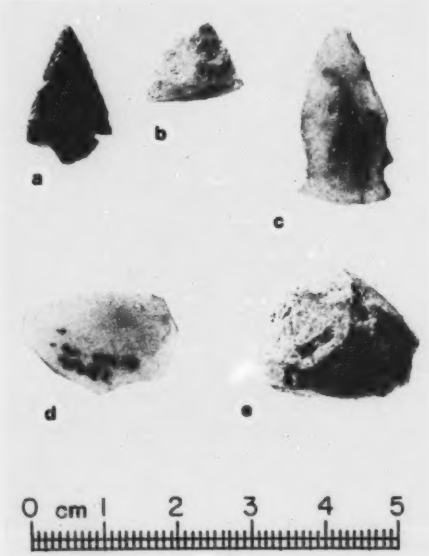


Figure 17.7. Projectile points (a-c), MURL (d), and bipolar core (e) from Layer XIII.

Projectile points (n=3). Catno 5798, a nearly complete specimen, is made of translucent off-white petrified wood (see Fig. 17.7). It is lanceolate with a slightly convex base and side-notches set just above the latero-basal point of juncture. One blade edge is bifacially retouched while the other has only unifacial retouching. The lateral edges immediately above both notches have been slightly broken, apparently as a result of edge (mis)shaping. The result seems more concordant with crude manufacture than with double notching, but that matter is open to question. One half of the basal edge either consists of a transverse fracture facet or has been broken off leaving such a facet. We are inclined to suspect it was broken by "end shock" since the tip at the opposite end is slightly crushed with tiny flake scars emanating from a crushed area indicating damage by impact. There is a small amount of powdered carbon on the point, and several areas on the surface have been seared to a brown colour as if the specimen had been in contact with fire. There is also a whitish residue speckled with charcoal on parts of both faces. The point was found in hearth F13-c and we conclude that it must have fallen or been tossed there before the fire cooled. One might speculate on the basis of smallness that this was an arrowhead. Application of the Thomas (1978) discrimination equations for arrowheads and darts yields values of $C_{dart} = 2.35$ and $C_{arrow} = 6.57$ which support the arrowhead interpretation. Given the crudeness of manufacture and the damage to basal and lateral edges, we do not attempt to classify catno 5798 to type but simply note that it is side-notched with a slightly convex base.

The other specimens, catnos 5832 and 5900, comprise only the bifacially retouched tips of projectile points. Catno 5900 is a very sharp tip which snapped along a hinge fracture across the long

Table 17.4. Chipped stone debris, excluding cores, from Layer XIII.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
agate	1	1	-	2	0.4	0.6	-	1.0
chert	4	2	1	7	14.6	0.2	2.4	17.2
chalcedony	1	-	5	6	1.3	-	11.9	13.2
Knife River Flint	8	2	9	19	17.8	0.2	2.3	20.3
limestone	2	-	-	2	7.3	-	-	7.3
obsidian	-	-	3	3	-	-	0.4	0.4
petrified peat	140	17	46	203	403.8	50.1	114.8	568.7
petrified wood	12	14	23	49	37.6	3.3	21.4	62.3
quartz	38	1	1	40	87.0	4.6	0.3	91.9
Swan River Chert	4	9	2	15	0.5	9.3	0.4	10.2
silicified sediment	-	-	1	1	-	-	<0.1	<0.1
Total	210	46	91	347	570.3	68.3	153.9	792.5

axis of the point. The tip and edges bear microscopic traces of a granular reddish material, probably blood haemoglobin. Thus, it seems likely that the point hit an animal, broke, and was brought to fireside (F13-c) in the meat. Catno 5900 was found in XU 6 outside hearth F13-c and, by its vertical position, was most likely associated with sublayer XIIIb. Catno 5832 is the mid section of a tip. A 1-2 mm portion of the tip snapped off along a transverse hinge fracture and was not recovered. Catno 5832 broke along another transverse hinge fracture lower down the blade. One edge is sharp while the other is dull. There is a whitish residue mixed with powdered charcoal on parts of both faces; no other residues are apparent. Catno 5832 was recovered from hearth screenings in XU 5 but, since hearths F13-a and F13-b were one above the other in this unit, it is not clear with which the tip was associated.

Chipped Stone Debris

The values in Table 17.4 represent a mixture of materials from sublayers XIIIa and XIIIb. There are, however, a few interesting observations which can be made about this chipping debris as a whole. The first is that Layer XIII occupants placed heavy reliance on a certain locally available raw material. The predominance of petrified peat is very strong, 72% of the sample by weight and 59% by number. A second point concerns the absence of quartzite. One notices that almost all chipping materials are of the higher grades, those usually chosen for small fine tools such as projectile points, endscrapers and knives. Local quartzites were apparently of no interest as Layer XIII occupants neither used nor replenished large quartzite chopping and scraping tools. Exotic materials, however, make a fairly strong showing including Knife River Flint, obsidian, and possibly also chalcedony, agate and Swan River Chert, all from sources to the southeast and southwest. This may indicate the usual raiding or trading orientation of the occupants. The small range of tools — an anvil, projectile points and a uniface knife — is suspiciously like what one might expect of a special purpose group such as a hunting or raiding party. A final general observation concerns distribution. That the majority of chipping materials were found in XU 4, not in units containing hearths, strikes us as unusual. We suspect that the concentration of debris in the hollow at the east edge of sublayer XIIIb may be the major contributor to this high value and we further suspect that there is a feature in that area which we did not recognize. There was one very small bipolar core of Swan River chert among Layer XIII remains (catno 5778, Fig. 17.7e). It was 2 cm long, weighed 3.2 g and was found in XU 5.

Faunal Remains

The distribution of vertebrates shown in Table 17.5 is undiminished by sampling for radiocarbon dating.

Bison, NISP=42: maxilla containing M^1 (AG 3-4), unassigned upper molar fragment, mandibular symphysis, M_2 (AG B), M_2 (AG 4?), M_3 (AG 5), $I_?$, P_3, thoracic neural spine, three ribs, three scapula blade fragments, four humerus shafts, three proximal radii ♀/© ♂, three radius shafts, ulna shaft, front 2nd phalanx, ilium, two femur shafts ©, distal femur ©, seven tibia shafts, talus ♀/©, hind 2nd phalanx, two 3rd phalanges. Bison portions representing at least three dental age groups and all three age/gender groups are included here. Six elements were found in hearth F13-b, and one came from hearth F13-c. A scapula blade, a humerus shaft, and an ulna shaft are charred. Most of the bones were fractured when fresh. A mandibular symphysis was broken off through the diastema, possibly to aid in removal of the tongue. Marrow extraction is indicated by impact scars on humerus, radius, and tibia shafts, and some of the fresh-fractured pieces can be conjoined. For example, a posterior fragment of radius in XU 4 conjoins an anterior fragment in XU 6 (Fig. 17.1, dotted line). One tibia can be reconstructed from two fragments in XU 6 and another from four fragments in XU 5. The distal femur has been gnawed by a carnivore. Of only six weathered bones, three have reached Stage 2. Rootlet etching is more ubiquitous with 22 specimens etched to a moderate degree.

Size 5-6 mammal, unidentified, n=66: one cranial, 13 tooth, eight rib, two costal cartilage, 41 long bone fragments, one phalanx. The predominance of long bone fragments is consistent with the emphasis on limb regions seen among identified bison bones as well as with the evidence for marrow fracturing. Four charred and two calcined specimens occurred in hearths F13-b and F13-c.

Deer or Pronghorn, NISP=1: rib shaft. From its complete ossification, this rib appears to represent an adult, but it is much too gracile to be from a bison. It was found in hearth F13-c.

Wolf, Dog or Coyote, NISP=1: 2nd phalanx. It is complete and etched by rootlets. This bone was found in the northeast corner of XU 4 amid a scatter of bison bones and coarse rock in sublayer XIIIb (Fig. 17.1).

Table 17.5. Vertebrate remains from Layer XIII.

	Number				Weight			
Size, Taxon	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
6, Bison	13	13	16	42	306.7	447.5	694.5	1,448.7
5-6, mammal	21	18	27	66	98.5	90.3	180.6	369.4
5, Deer or Pronghorn	-	-	1	1	-	-	1.9	1.9
4-5, Wolf, Dog or Coyote	1	-	-	1	0.6	-	-	0.6
3, mammal	-	-	1	1	-	-	0.1	0.1
-, mammal	135	145	416	696	104.8	93.2	238.0	436.0
Shoveler?	-	-	1	1	-	-	0.6	0.6
Bird eggshell	-	-	+	+				
Toad	-	-	*24	24	-	-	1.3	1.3
Total	170	176	486	832	510.6	631.0	1,117.0	2,258.6

a. Superscript (*) signifies that these elements are thought to be intrusive into this layer.

Table 17.6. Modified vertebrate remains from Layer XIII.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	-	3	1	-	6	38	6	-	7	26	3	42
5-6, mammal	-	6	-	-	*	*	13	1	4	48	-	66
5, Deer or Pronghorn	-	-	-	-	-	1	-	-	-	1	-	1
4-5, large canid	-	-	-	-	-	1	-	-	-	-	1	1
3, mammal	-	-	-	1	-	-	-	-	-	1	-	1
-, mammal	-	170	-	9	*	*	-	*	*	*	-	696
Shoveler?	-	-	-	-	-	-	-	-	-	1	-	1
Toad	-	-	-	-	-	-	-	-	-	-	24	24

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

Size 3 mammal, unidentified, n=1: long bone shaft fragment.

Unidentified mammal, n=696: fragments, all but 26 of which are less than 4 cm long. Nine digested elements are present despite the absence of tooth-marked bones; seven of them occur in XU 4. Hearth F13-c is the main source of 90 charred and 80 calcined specimens.

Shoveler?, NISP=1: distal humerus. This bone was found in hearth F13-c. The Shoveler is a moderately common breeding bird on sloughs and potholes in the Prairie Provinces (Godfrey 1966:64). Bent (1962:135-141) states that this species is a relatively late spring migrant, delaying its arrival until the ice has left the sloughs, and one of the earliest fall migrants, departing with the first autumnal frosts. Salt and Wilk (1966:60) note that most shovelers have left Alberta by early October.

Therefore, the humerus, and perhaps the entire Layer XIII bone assemblage, represents the summer season.

Bird, unidentified: eggshell fragments from XU 6. Judging from thickness measurements, these fragments are from the egg of a bird about the size of a duck, a gull, a heron, or a hawk.

Toad, NISP=24: various bones thought to comprise parts of one skeleton. The high prominences on the ilia are typical of the *americanus* group of toads that includes *B. cognatus*, *B. woodhousei*, *B. americanus*, and *B. hemiophrys* (Tihen 1962). All four species occur in or near southern Saskatchewan, but only the last-named (sometimes treated as a subspecies, *B. americanus hemiophrys*) presently lives in the Sjovold area (Cook 1984). Unusually light tan staining and absence of rootlet etching suggests that these bones are intrusive into Layer XIII. They may represent a toad that died in its hibernaculum. Whereas toads normally burrow about 1.0-1.3 m to position themselves beneath the frost for hibernation (Froom 1982; Preston 1982; Tester and Breckenridge 1964), Layer XIII is about 2.5 m below the modern surface. Hence the burrow probably was dug from an ancient surface, and the toad may have succumbed to frost penetrating its hibernaculum from the nearby cut bank.

Snail: One small gastropod was recovered from XU 6.

Plant remains: A charcoal sample (22 pieces, 3.1 g) was collected from hearth F13-c.

Discussion. From their close association with hearths and from evidence for systematic fresh-state fracturing, portions of at least three bison, a deer or pronghorn, and a duck contributed to the subsistence economy of Layer XIII. Fragments of a duck-sized egg may indicate a dietary supplement that was acquired along with the duck itself. Both the duck and the egg indicate a summer season for this occupation. The significance of the canid phalanx is unclear.

Interpretation of Layer XIII

Layer XIII comprises two separate phases of occupation that we were able to separate only partly. Sublayer XIIIa, the upper or latest occupation, was represented by a shallow wood-burning hearth surrounded by a sparse scatter of coarse rock, fragmented bone and chipped stone debris. Sublayer XIIIb contained two wood-fuelled hearths with deep subsurface soil burns, a slightly greater amount of surrounding debris, and a separate concentration of debris which is probably associated with another feature. By comparing thicknesses of hearths we can infer that XIIIa supported a briefer occupation than that of XIIIb. Tools associated with a specific sublayer are a small uniface knife with XIIIa, and two projectile points and a stone-chipping anvil with XIIIb. Subsistence in Layer XIII was based on parts of three bison, a deer or pronghorn, a duck and eggs of duck size, with most of the remains being associated with XIIIb, and specifically with hearth F13-c. The duck bone was in the hearth and the egg shells beside it. Given the reproduction and migration patterns of ducks in this region, occupation of XIIIb was evidently a warm season affair.

The activities represented by combined remains included the dismemberment, cooking (probably by stone-boiling), bone breaking, and consumption of game; the disposal of fractured residues around and into the hearths; manufacture of new stone tools, mainly using local petrified peat, and rejuvenation of other tools made of a greater variety of materials, some of them exotic to the region. If the few discarded tools are indicative of those which were replaced or rejuvenated, then the majority were probably projectile points. This notion finds support in the presence of generally fine-grained chipping materials usually used for such tools, and in the absence of readily available and commonly used coarser materials such as quartzite. The significance of the missing quartzite is that such material was often used for tools such as scrapers and choppers, items which would imply a broader range of campsite activities. Together, these observations are evidence for the presence of special purpose group(s) in Layer XIII, possibly hunting or raiding parties.

Further clues about the groups' identity(s) are skimpy. The predominance of petrified peat among chipping materials suggests that occupants were familiar with the locality, probably that they were regional residents. The single nearly whole projectile point from Laver XIII is side-notched with a straight to slightly convex base. Though we are reluctant to classify it because of the crudeness of its manufacture, such characteristics match those of a type known for the Besant series. There would seem to be no similar correspondence with any other complexes or types known for this era on the northern Plains. The age of Layer XIII is estimated to have been between 750 and 450 BC (cal 2700-2400 BP; Table 3.6).

Interlayer XIII/XIV

Coarse Rock from Interlayer XIII/XIV includes 90 specimens weighing 2,433 g (Table 17.7). Granite and gneiss comprise a substantial majority of the sample as was also the case in Layer XIII above. Except for basalt and limestone, virtually all pieces were fire-broken.

Chipped Stone Debris includes most of the materials in approximately the same proportions as was found in Layer XIII (Table 17.8). Petrified peat is strikingly dominant in both. Therefore, it seems probable that the interlayer chipped stone was derived mainly from Layer XIII. There are two cores, both from XU 5: a very small bipolar core of petrified peat (catno 6095) weighs 5.5 g; and a large simple quartzite core (catno 6107) weighs 408.4 g. The petrified peat core is consistent with a Layer XIII origin. However, the quartzite core would be anomalous in Layer XIII. There was also very little quartzite in Layer XIV. The closest layer with similar quartzite is XI. A likely mode of transport between Layer XI and Interlayer XIII/XIV would be by animal burrow.

Table 17.7. Coarse rock from Interlayer XIII/XIV.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
basalt	-	6	-	6	-	123	-	123
gneiss	-	3	-	3	-	514	-	514
granite	19	14	-	33	564	931	-	1,495
grano-gneiss	-	1	-	1	-	22	-	22
limestone	1	10	-	11	1	18	-	19
quartzite	-	7	-	7	-	233	-	233
unidentified	15	14	-	29	11	16	-	27
Total	35	55	0	90	576	1,857	0	2,433

Table 17.8. Chipped stone debris, excluding cores, from Interlayer XIII/XIV.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
Knife River Flint	3	-	-	3	0.5	-	-	0.5
petrified peat	-	19	-	19	-	70.7	-	70.7
petrified wood	-	1	-	1	-	0.6	-	0.6
quartz	-	3	-	3	-	2.4	-	2.4
Swan River Chert	-	2	-	2	-	5.9	-	5.9
silicified sediment	-	1	-	1	-	4.7	-	4.7
Total	3	26	0	29	0.5	84.3	0.0	84.8

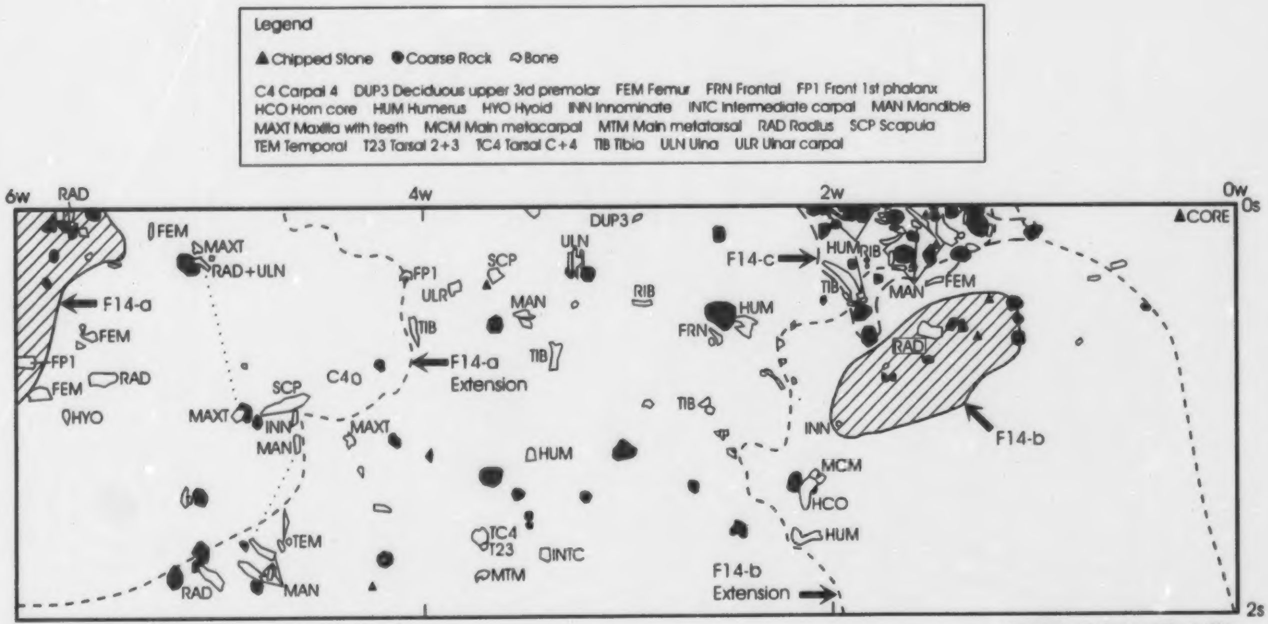
Faunal Remains:

Bison, NISP=1 (3.6 g): lower premolar fragment, etched by rootlets.

Size 5-6 mammal, unidentified, n=6 (13.5 g): five tooth, one long bone fragment. The long bone fragment was fractured when fresh.

Unidentified mammal, n=93 (46.1 g): fragments less than 6 cm in length. Of 28 burned fragments, most from XU 4, 16 are charred and 12 are calcined. There are also one tooth-marked and five digested fragments.

Interpretation of Interlayer XIII/XIV: interlayer materials were probably derived mainly from Layer XIII. The presence of substantial amounts of cultural materials in this position is best accounted for in terms of undulations in the occupation surfaces of Layers XII and XIV, although animal burrowing which penetrated Layer XIII and connected with higher layers may also have played a role.


Legend
▲ Chipped Stone ● Coarse Rock Bone
C4 Carpal 4 DUP3 Deciduous upper 3rd premolar FEM Femur FRN Frontal FP1 Front 1st phalanx
HCO Horn core HUM Humerus HYO Hyoid INN Innominate INTC Intermediate carpal MAN Mandible
MAXT Maxilla with teeth MCM Main metacarpal MTM Main metatarsal RAD Radius SCP Scapula
TEM Temporal T23 Tarsal 2+3 TC4 Tarsal C+4 TIB Tibia ULN Ulna ULR Ulnar carpal
6w
4w
2w
0w
0s
2s
▲CORE
RAD
FEM
MAXT
RAD+ULN
F14-a
FEM
FP1
FEM
RAD
HYO
MAXT
SCP
INN
MAN
C4
FP1
ULR
TIB
F14-a Extension
MAXT
SCP
MAN
ULN
DUP3
TIB
RIB
HUM
TC4
T23
INTC
MTM
TEM
MAN
RAD
F14-c
HUM
RIB
TIB
MAN
FEM
HUM
FRN
TIB
RAD
INN
F14-b
MCM
HCO
HUM
F14-b Extension

Planview by ID, Corel rendition by REM

Figure 18.1. Planview of Sjovold Layer XIV.

Chapter 18

Layer XIV: Outlook Points and the Arrival of Besant

Introduction and Planview

Layer XIV extended from 252 cm to 263 cm BS at 0n2w, although in most places it was only about 6 cm in thickness. Excavations revealed two hearths, each containing and surrounded by bone, chipped stone and coarse rock debris, and each adjoined by an apron of scattered charcoal. A distinctive straight-based, side-notched type of arrowpoint was found in this layer, and we assign the name "Outlook Side-notched" to the type. A radiocarbon date on bone indicates that occupation occurred between 850 and 550 BC (cal 2800-2500 BP; Table 3.6), and we interpret the "Outlook Side-notched" type as a very early manifestation of the Besant series. There was a slight hollow in the occupation surface in XU 5 and a slight rise in XU 4. Small animals had made an branching burrow system, about 5-8 cm in diameter, immediately below the occupation surface. In a couple of places, burrows that were infilled with a grey-brown sandy/silty soil passed obliquely or vertically through the occupation debris. Some Layer XIV artifacts may have been introduced into Interlayer XIV/XV by this burrowing. Altogether, there were 17 cm of silty deposits between Layers XIV and XV. However, about 9 cm below XIV there was a very sparse occupation layer which we neither labelled nor separated from other interlayer materials. It contained one small shallow hearth and a few large fragments of bone and chipped stone. In addition to materials from this trace occupation, the interlayer seems to have contained small amounts of cultural materials from Layer XIV and possibly also from the top of Layer XV. Deposits from the west half of XU 6, from 5 cm below Layer XIV to the top of the interlayer trace occupation, were discarded unscreened, although any materials discovered during excavation were saved. All other interlayer deposits were screened, and all recovered materials were saved.

The Layer XIV planview (Fig. 18.1) shows the locations of two hearths, each with an extension of scattered charcoal, and a dense cluster of debris. All of the labelled bones have been identified as bison, and most of them represent cranial and appendicular elements along with a few ribs. Conjoinable pieces include left and right maxillae and two mandible fragments in or near the F14-a extension. The two ribs labelled within F14-c can also be conjoined, and both ends of the reconstructed bone have been used as pressure flakers.

Features

Feature F14-a (Figs. 18.1-18.2, Table 18.1) was a shallow surface hearth about one half of which was exposed in the northwest corner of XU 6. The feature was comprised of three horizons.

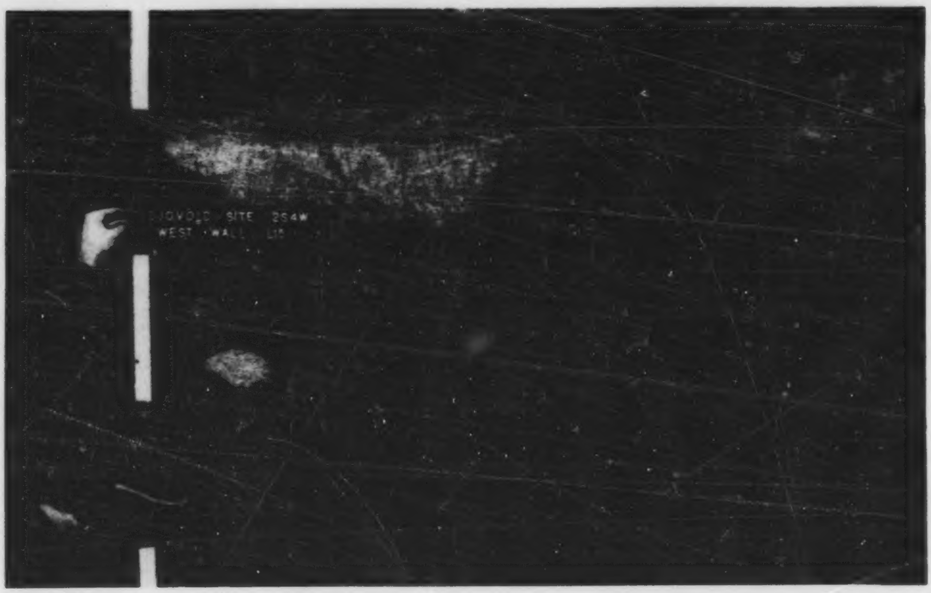


Figure 18.2. Northeast corner of XU 6 showing the relative thicknesses of hearths F14-a and F15-a. RSM #EiNs-4:80-363 CT.

Uppermost was a 3-4 cm thick layer of grey-brown soil with black speckles and small pieces of charcoal. It contained several hundred fragments of charred and calcined bone, 6,880 g of fire-broken rock, 89 pieces of chipped stone debris, seven broken projectile points, and one stone anvil. We presume that this was the active, above-surface part of the hearth. Beneath was a thin middle layer, about 0.5-1.5 cm in thickness, which was comprised of powdered charcoal-infused earth with occasional vertical gaps or holes filled with grey-brown soil. All the larger pieces of fire-broken rock were seated in this middle layer which was equivalent in elevation to the living floor of the occupation and about 2 cm above the base of what we have described as Layer XIV. The bottom of the hearth was a 1-2 cm thick zone of grey-brown and reddish-brown earth spiked with black stains extending 1-2 cm downward from the charcoal layer. Presumably the grey and reddish colour of the lower zone was due to subsoil heating by fire. The black spikes seem to reflect seepage of water after abandonment. Soil colours in this lowest zone were most pronounced immediately below the charcoal layer and faded rapidly with increasing depth until the hearth burn became indistinguishable from interlayer soils.

In comparison to other wood-fuelled hearths in the Sjovold site, the subsurface soil scorching of F14-a is unusual for its shallowness. It is possible that the fire was extremely short-lived. Countering this idea, however, is the substantial amount and variety of debris in the upper layer of

Table 18.1. Features in Layer XIV.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F14-a	surface hearth	25s600w	>95	>55	6
F14-b	surface hearth	75s150w	73	95	4-6
F14-c	debris cluster	5s155w	>65	115	11

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

the hearth, debris whose generation would have required at least an hour, probably several hours, of fireside work. Another possibility is that the hearth was built on a damp or frozen surface which absorbed a good deal of heat before registering the effects of subsoil roasting. We don't have controlled comparative observations against which to evaluate such an idea, but it is our guess that kind of fire would have produced a damp messy hearth which would be difficult to keep in operation. Yet another alternative, and the one we prefer, is that a layer of combustible material, perhaps a bed of bavins (segments of mid-sized branches and tree trunks), was laid down as a dry base on which to build a fire, a base which would have separated the fire from a frozen, or snow-covered, or damp surface. Such a base would, itself, eventually have burned, but its presence would have delayed or minimized heat penetration into the subsurface.

We noted that there was a patch of reddish-brown soil in the upper layer of F14-a and another reddish patch a short distance beyond its eastern periphery. At first we thought that these were evidence for soil heating associated with F14-a, and/or an ochrous substance lost or discarded near the fire. After re-examining our records, however, we have adopted a simpler explanation encompassing both bits of reddened soil. A field photograph of a profile passing through hearths F13-c and F14-a clearly shows that the heated subsoil below F13-c extended down to the top of F14-a. Consequently, we believe that the two patches of reddened soil seen in the upper to middle zones of F14-a had no association with F14-a at all but, instead, were basal expression of a deep subsurface soil scorching under F13-c.

Materials on the peripheries of F14-a included a few pieces of stone and bone amongst a thin scatter of charcoal extending 2 m east, southeast and south from the edge of F14-a (the occupation surface in other directions was not exposed). The bone and stone debris was somewhat more concentrated close to the F14-a hearth and at the outer limits of the charcoal scatter. Beyond that, extending 3 m farther to the east, was an open scatter of stone and bone debris on a buff-brown occupation surface. This covered the space to the next complex of features, F14-b and F14-c.

Feature F14-b was a surface hearth whose internal stratigraphy can also be described in three levels. The upper level was 2-3 cm thick, and consisted of brown earth mixed with chunks, flakes and powder of charcoal, a couple of hundred fragments of charred and calcined bone, eight fragments of fire-broken rock weighing 562 g, a few fragments of uncharred bone, ten pieces of chipped stone debris (Knife River Flint, silicified sediment, chert and fused shale) weighing 8.8 g, and one broken projectile point (catno 6233). A thin middle zone was a mixture of charcoal (chunks and powder) and red-brown soil. The bottom of the feature, a reddish/brown charcoal-stained zone 1-2 cm in thickness, was apparently just below the occupation surface. F14-b was recorded as having an oblong shape with a northeast-southwest orientation, however, our excavation technique produced a planview which may have been slightly skewed to the plane of the occupation surface, particularly in XU 4. Therefore, the southeast edge of F14-b may not have been fully exposed in our planview and may have extended somewhat more to the southeast beneath a 1-2 cm thick wedge of buff-brown silt. In that case its true shape could have been more round than oval. In any case, F14-b is another hearth with an unusually shallow subsurface burn for a wood-fuelled fire. We propose the same interpretation as for 14-a, namely, that the hearth was slightly above the occupation surface on a dry bed of combustible material.

Materials surrounding F14-b included: (1) an apron of scattered charcoal, bone and stone debris spreading at least 1.25 m southeast to the limit of excavations; (2) an open 2 m wide scatter of rock, broken bone and a few larger pieces of chipped stone debris on buff-brown soil between the charcoal scatters associated with F14-a and F14-b; and (3) a cluster of rock and bone debris, F14-c, adjoining to the north. The apron of scattered charcoal associated with F14-b lay mainly to the southeast. There was a 15-25 cm wide collar to the east, west and north of the hearth, but the charcoal diminished very rapidly in those directions. An inference that can be generated from such an arrangement, so similar to that around hearth F14-a, is that these charcoal scatters are a reflection of a northwest wind sweeping across the hearths and carrying charcoal to the scatter areas. Supporting evidence can be is that other debris was generally scarce in the areas of charcoal scatter, but seemed to increase on some parts of the peripheries. This sparseness of debris may be an indication that the charcoal areas were not suitable for habitation during hearth use because of heat, smoke and charcoal particles carried there by wind.

Two possible explanations come to mind for the open scatter of fired rocks and bone fragments between the hearths F14-b and F14-a. One is that the debris marked an area in which such materials were used and discarded; another is that it represents a discard or toss zone for materials whose use was elsewhere. The medium to large sizes of debris in this inter-hearth area, particularly of the chipping debris, leads us to favour the toss-zone interpretation since the presence of a wider array of debris size, especially small size, would be expected if debris had been discarded at the same site where it was created. If this interpretation is correct, then most fireside activities probably occurred on the north and northwest sides of the hearths.

Feature F14-c was a fairly tight surface cluster of fired rock, fragmented bones, a few pieces of stone chipping debris and one stone tool situated about 15 cm north of F14-b. Only the southern part of F14-c was exposed by our excavations, but it appears that we caught the southern half of a feature whose overall shape may have been roughly circular. The edges were irregular and a couple of outlying pieces almost touched the north edge of F14-b. Evidently, the contents were not closely confined. The dominant component was large and medium fragments of fire-broken rock, mainly granite and gneiss, 128 pieces weighing 15,909 g. Next in importance were large and medium-size fragments of large mammal bones and teeth — at least 17 pieces together with some smaller fragments. Chipping debris was a very small component — 17 pieces weighing 9.1 g, all being Knife River Flint. A single stone tool definitely situated within the feature was a retouched flake. Two other retouched flakes and a biface fragment were found in the same excavation unit and may have been part of the feature. Two rib fragments can be conjoined end-to-end, and opposite ends of the reconstructed bones have used as pressure flakers. Profile photographs show that F14-c was immediately underlain by a long horizontal rodent burrow which had been infilled with a grey-buff sandy-loam soil. Consequently, the base upon which the feature once rested has been lost, at least in the area recorded in our profile. It would appear, however, that the great majority of feature debris lay on the horizontal plane on which most Layer XIV materials were found. Presumably this was the occupation surface. A few exceptions were pieces of debris piled on top of pieces in the main group. The thickness of the feature was measured up from the feature's basal plane and to the top of its largest object. Though rodent disturbance somewhat compromises our observations, it appears that the surface upon which F14-c rested was composed of buff-grey silt and that it did not contain charcoal or ash.

We interpret F14-c as having served a combination of activities by a person or persons seated at the northwest and/or northeast corners of hearth F14-b. One of the functions may have been as a rock drying or holding area near the fireside. The same fired rocks could have served as a platform for roasting bones, and also as anvils upon which bones were broken for marrow. A person(s) using the rocks as bone-breaking anvils might have left some bone fragments where they fell while tossing others, picked or pried off cracked bones, to one side thereby creating the open zone of surface debris between hearths F14-b and F14-a. F14-c also appears to have served as a discard area for chipped stone debitage and at least one stone tool which indicates that some tool use and rejuvenation took place nearby. The bone pressure flakers reinforce this interpretation.

Rock

The most common coarse rock in Layer XIV is granite with 49.8% of the total weight (Table 18.2). Other materials with showings above 3% are grano-gneiss (17.1%), gneiss (13.7%), sandstone (8.2%) and limestone (3.9%). The great majority of the sample exhibits exposure to fire, exceptions being the limestone and a few pieces of granite, sandstone and gneiss. The average weight is 50.53 g which is below the site average (159.8 g). For a layer in which most coarse rock was fired, disaggregation was only moderate. One could infer, therefore, that intensity and duration of use as fired (boiling) stones was also only moderate. Other layers with similar levels of disaggregation are Layer I with an average weight of 51.9 g, Layer III (48.9 g) and Layer XIII (44.3 g).

Table 18.2. Coarse rock from Layer XIV.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
amphibolite	1	1	1	3	977	36	156	1,169
andesite	-	1	-	1	-	1	-	1
basalt	1	3	-	4	14	39	-	53
chert	-	-	1	1	-	-	410	410
concretion	-	-	2	2	-	-	*	0
diabase	1	-	-	1	93	-	-	93
dolomite	-	-	1	1	-	-	29	29
gneiss	16	24	44	84	2,422	2,073	1,562	6,057
granite	161	110	258	529	9,386	5,754	6,804	21,944
grano-gneiss	40	3	7	50	4,586	1,595	1,335	7,516
limestone	4	19	8	31	1	43	1,627	1,671
quartzite	11	2	12	25	926	22	345	1,293
sandstone	18	21	14	53	1,537	1,782	282	3,601
unidentified	24	24	44	92	54	42	127	223
Total	277	208	392	877	19,996	11,387	12,677	44,060

All of the coarse rock in Layer XIV could have been obtained from nearby surface sources. The combined total of granite, gneiss and grano-gneiss in Layer XIV (80.6% by weight) is a little higher than the combined total of such rocks in local sources (69.8%; Dyck 1990). Similarly, the amount of sandstone in the site (8.2%) is higher than in nearby sources (2.3%). However, limestone (3.9%) is in lower proportion than in local sources (11.2%). Thus, it could be interpreted that coarse rock in the site was collected almost randomly from local sources, with slight preferences for granite, gneiss, grano-gneiss and sandstone and slight avoidance of limestone. Since the main use of the granite group was as firing-stones, a use requiring a substantial quantity of rock, and since the only observed uses for limestone were as hammerstone and anvil, functions requiring much less rock, such patterns make sense.

Stone Tools

Anvil/hammer (n=1). Catno 6352, found within hearth F14-a, is a slab of buff-coloured limestone (Fig. 18.3, Table 18.3). It has two opposing flat faces. Toward the center of one face is an incised groove-like pit about 24 mm long by 5 mm wide by 1 mm deep, the cumulative result of at least ten smaller parallel incisions apparently due to impacts with a small sharp hard object such as the edge of a stone tool or the base of a bipolar chipped stone core. There are also four small incisions touching the "groove" at an orientation nearly perpendicular to that of the pit. Thus, some of the incisions were made by edges at orientations different to those of the main groove. Covering most of the groove surface and about 30% of the adjoining flat surface is a thinly spread, rusty-red, somewhat

Table 18.3. Stone tools from Layer XIV.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
anvil/hammer	6352	6	403.3	88	76	41	limestone	y	18.3
biface knife	6436	4	14.5	40	40	4	Knife River Flint	n	18.4n
endscraper	6226	6	0.7	22	14	3	fused shale	y	18.4l
MURL	6447	4	1.7	20	22	2	silicified sediment	n	18.4m
MURL	6791	4	4.7	44	25	5	Knife River Flint	y	18.4o
MURL	6817	4	2.8	30	22	3	Knife River Flint	?	18.4k
projectile point	6233	4	2.6	30	16	3	Knife River Flint	n	18.4a
projectile point	6263	6	1.4	20	18	5	Knife River Flint	n	18.4d
projectile point	6264	6	2.5	28	18	3	Knife River Flint	n	18.4b
projectile point	6265+	6	2.1	21	20	3	Knife River Flint	n	18.4c
projectile point	6267	6	0.3	8	15	2	Swan River Chert	n	18.4h
projectile point	6274	6	0.7	17	14	2	Knife River Flint	n	18.4j
projectile point	6312	6	0.6	8	18	3	silicified sediment	n	18.4f
projectile point	6323	6	1.0	14	15	5	fused shale	n	18.4i
projectile point	6725	5	0.5	13	11	3	buff-cream chert	n	18.4g
projectile point	6790	4	1.5	29	13	3	Knife River Flint	y	18.4e

granular substance. Two possible identifications for this substance are blood residue and surface colour change due to heat alteration. Our preference is blood residue for reasons which will be elaborated shortly. Meanwhile, the presence of a reddish substance over the surface of the incisions leads us to the inference that impacts which caused the incisions occurred before deposition of the residue.

One side of Catno 6352 is a naturally fractured, roughly flat surface. The two ends and other side, however, are very irregular. They have been shaped by removal of numerous large flakes. Among the flake scars are four crushed pinnacles, the two most prominent ones being situated at the center of one side and at the center of an adjoining end. Two lesser pinnacles are situated on either side of the prominent pair at junctures between face and edge surfaces. The four pinnacles, including the flake scars radiating out from them, are 50-90% covered with a rusty-red film, similar to that on the incised groove. The single natural edge and remaining flat face are less than 1% covered by that film. Thus, the reddish material is strongly associated with the pinnacles and clearly not associated with the unmodified flat surfaces. Therefore, in the absence of chemical tests, we have adopted a tentative interpretation that it is blood residue. Closer microscopic inspection supports such an interpretation, as reddish materials tend to be densest in the middle reaches of cracks and pits and less concentrated in deeper, hard-to-reach cavities and on micro-prominences of surface bumps. One would expect a more uniform coverage and deeper penetration of reddening had the colour been due to heat alteration.

Our interpretation of catno 6352 has two parts. We believe that one flat surface was used as an anvil against which a hard sharp object was struck leaving the observed incisions. Stone chipping

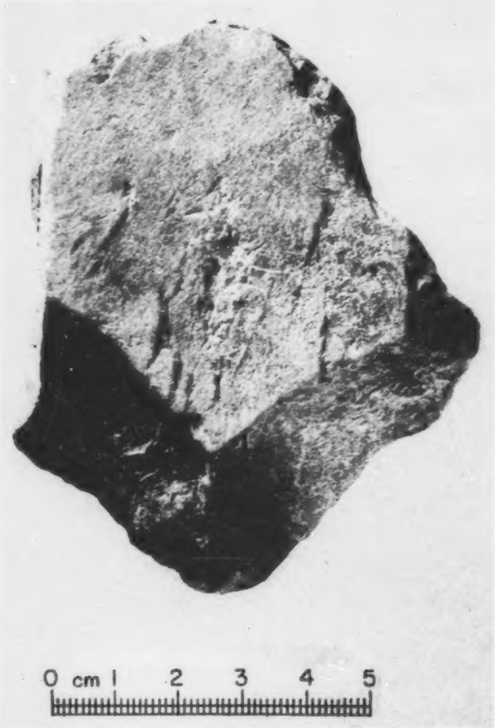


Figure 18.3. Anvil/hammer from Layer XIV.

seems a likely possibility. Subsequent to that use, the edges of the tool, particularly pinnacled parts, came into impact with bloody or blood-bearing objects. The presence of pinnacles on the impact surfaces accords well with the needs of a bone-breaking instrument, a tool which (whether used as anvil or hammerstone) could deliver considerable force to a small area. The crushing observed on the pinnacles and the distribution of what we believe to be blood residue around them is further support for a bone-breaking interpretation. Possible *ad hoc* anvils with a bone-breaking hammerstone have already been identified as part of F14-c at the side of hearth F14-b. There may have been similar *ad hoc* anvils in the unexposed area near 14-a where catno 6352 was found.

Biface knife (n=1). Catno 6436 is an end piece of a medium-size biface made of Knife River Flint. The two sides are roughly parallel and have been systematically thinned by a combination of large (mainly), medium and small flakes, leaving slightly sinuous sharp edges. There is light dulling and polish on parts of these edges. The basal edge is thicker and slightly skewed from a position perpendicular to the sides. Only three thinning flakes were removed from one face of the basal edge leaving it thick, irregular and dull. The line along which the object broke is fairly straight. It runs diagonal to the long axis of the tool and roughly parallel to the base. The fracture began vertical to one face and was transformed into a curved hinge fracture before exiting on the other. This suggests snapping. There are minute traces of a reddish substance, presumably blood residue, on parts of the basal and side edges. There are also slightly larger quantities of white calcium carbonate in deeper flake scars across the tool. Minuscule pieces of charcoal can be seen in some places against the white background of calcium carbonate. Our guess is that catno 6436 was the base of a mid-size, "square-based," biface knife used for dismemberment of game parts brought into camp. The hinge fracture is evidence for breakage under a levering action. The traces of charcoal and location in XU 4 suggest disposal in hearth F14-b.

Endscraper (n=1). Catno 6226 is an endscraper made on the thickest side of a thin rectangular cortical flake of fused shale. Steep unifacial retouch runs the length of one side. The resulting edge has been severely worn from the underside so that the juncture between ventral face and retouched edge has been bevelled flat. The flatness has a width of 1 mm and runs the length of the edge. It is polished, has striae running at right angles to the long axis of the edge, and is slightly rounded. There are a few minute particles of charcoal on the faces of the tool, but other residues seem to be absent. Though this piece is technically a side-scraper, its critical functional characteristics (steep unifacial retouch on a fairly thick edge, and heavy transverse edge wear) are those of an endscraper. Our records for its provenience are only specific to XU 6 but, by the presence of adhering charcoal, it appears that catno 6226 was discarded into hearth F14-a.

MURLs (n=3). Three MURLs were found in XU 4. Catno 6791 lay within F14-c; the specific locations of the others were not recorded. Catno 6447 is heat crazed and may have come from (the top of) hearth F14-b. Each of the MURLs is a minimally modified cutting tool made on one side of a rapidly expanding flake. All have fine unifacial retouching and/or use-nicking, and polish, along the cutting edge.

Projectile points (n=10). One whole and nine broken projectile points were found in Layer XIV (see Fig. 18.4). Catno 6790, a whole but crude specimen, was located in F14-c. Catno 6233, a well-made point missing a small part of its tip and one corner of its base, was in the upper part of F14-b. Catno 6725, a small edge fragment of a severely shattered biface which may have been a projectile point, was in the toss zone between hearths F14-a and F14-b. All the other point fragments came from hearth F14-a. Three of these (catnos 6265, 6266 and 6508) could be refitted into the basal half of a point. The remaining parts represent six separate projectile points. Seven of ten fragments represent basal parts, an indication that spent projectiles retrieved to camp were being repointed at fireside.

The shapes of the points are surprisingly uniform, especially in the critical basal area. All are side-notched with straight or very slightly concave bases. Notches are low on the sides, 2 mm or less above the lateral-basal point of juncture. They are generally "u" shaped and about twice as broad as deep. Neck width, the distance across the haft between notches, averages 11.8 mm with a range from 10.6 mm to 13.1 mm for seven measurable specimens. The sides are almost straight, forming very gentle convex curves toward the tip. Lateral edges are sharp, perhaps lightly polished, but not ground. Basal edges are either lightly crushed or lightly rounded and polished by abrasion which left transverse striae. Basal width in three cases was equal to maximum width of the body just above the haft. In one case, width of the base was about 1 mm narrower than the body, and in other cases a comparison was not possible. The points are biconvex both in longitudinal and transverse section. Multiple flake scars cover both faces, except in the case of catno 6267, one face of which is dominated by a single flat flake scar. The general symmetry of notches, lateral sides and flaking leads us to infer that most of the points had not been reworked (cf. Zeier 1983). An exception is catno 6264 whose asymmetrical sides, mixture of fine regular and rough irregular flaking, narrow shoulders, and thick basal edge are consistent with reworking of a large blade fragment into a new point.

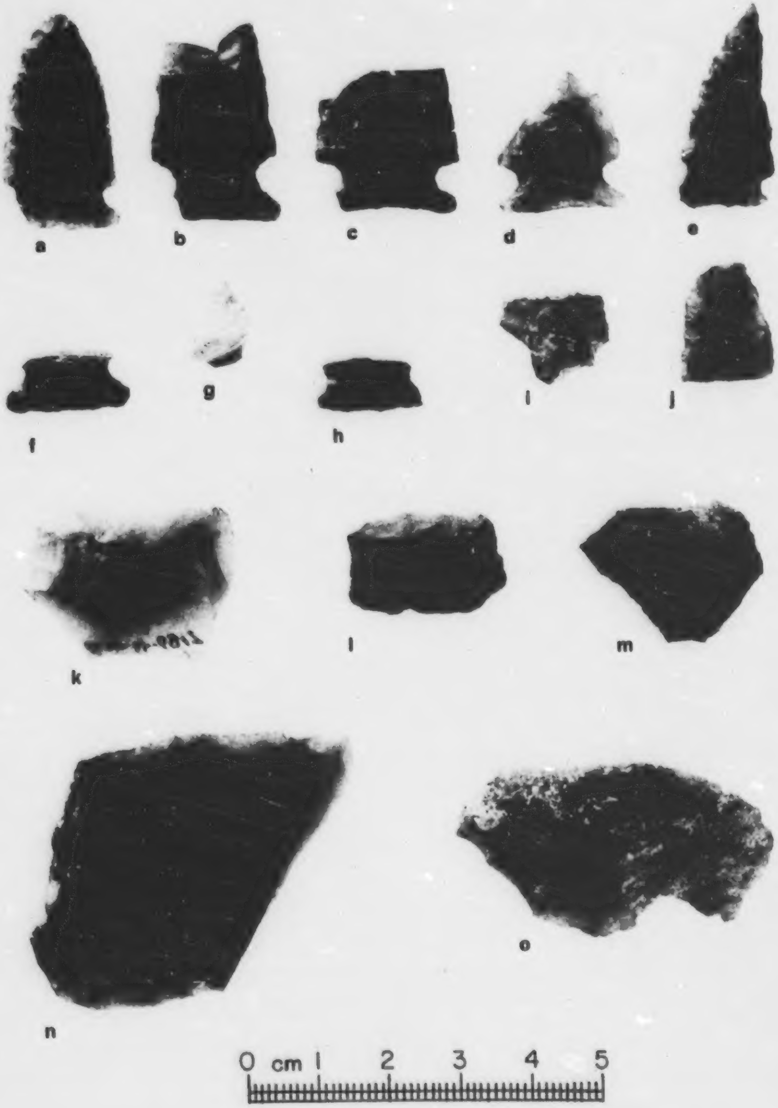

a
b
c
d
e
f
g
h
i
j
k
l
m
n
o
0 cm 1 2 3 4 5

Figure 18.4. Projectile points (a-j), MURLs (k, m, o), endscraper (l), and biface knife (n) from Layer XIV.

There is a white residue, presumably calcium carbonate, scattered through deeper crevices on all surfaces including fracture surfaces. There is also a minute granular rusty-red residue, presumably blood, in some flake crevices along the side and basal edges of five specimens (catnos 6233, 6263, 6265, 6274 and 6790). Most of the points were manufactured from lithic materials derived from sources 400-600 km south of the Sjovold site (Table 18.3).

Comparisons: Layer XIV occupation has been radiocarbon dated to between 850 and 550 BC, a poorly known period in northern Plains history. Three regional entities have previously been identified as belonging within this period. One is a putative late version of the Oxbow complex, sometimes referred to as "Remnant Oxbow" (Gibson 1981), characterized by distinctive "eared" projectile points with side notches and (usually deep) concave bases. Aside from persistent questions about the accuracy of Remnant Oxbow dates and whether Oxbow is the best identification for such materials (similarities between these points and Oxbow points are unmistakable, but there are also similarities with points of the Sandy Creek type), the projectile points are not at all similar to those in Layer XIV and, therefore, may be set aside from our comparisons. Another contemporary is Pelican Lake (ca. 3300-1850 BP; Wettlaufer 1955; Foor 1982; Reeves 1983b; Dyck 1983), a series characterized by corner-notched projectile points. Layer XIV points clearly do not belong within a corner-notched type and, therefore, Pelican Lake may also be set aside.

This leaves a third entity, Sandy Creek, which is said to be characterized by side-notched and concave-based projectile points (Wettlaufer 1955; Dyck 1983). In our discussion of Layer XII (Chapter 16) we proposed a revision of the notion that Sandy Creek is a separate complex, so that we consider it merely the name of a projectile point type, one of several types belonging to the Besant series. This draws a better known, but supposedly later, entity toward the present comparison. Besant includes side-notched projectile point varieties which may be concave-based, straight-based or convex-based (Wettlaufer 1955; Reeves 1983b; Johnson 1970; Kehoe 1974; Dyck 1983). The straight-based forms offer some excellent comparisons.

In terms of form, particularly of haft and basal areas, it is easy to find close comparisons between points from Layer XIV and points from occupations attributed to Besant. Examples of look-a-likes can be found at the Mortlach site (Wettlaufer 1955: Pl. 7, No. 1), the Kenney site (Reeves 1983a: Fig. 23, Nos. 9, 17-19), the Muhlbach site (Gruhn 1971: Pl. 5, Nos. c, d, f, h, m, Pl. 6, Nos. e, g, h, n, p-s), Wahkpa Chu'gn (Davis and Stallcop 1966: Pl. 3, No. g), the Walter Felt site (Kehoe 1974: Fig. 2, Nos. i, j, n, o, s-u, z), the Melhagen site (Ramsay 1991: Fig. 5.1, Nos. 10861, 10888, and 10893) and others. Some characteristics noted for Besant side-notched points are lateral edges which are convex (most common) to straight (rare); maximum width at the shoulder and/or base; cross sections are biconvex to plano convex; notches are broad shallow "u" or "v" shaped; basal thinning and grinding is very characteristic; bases may be convex, straight (most common), or concave; bases may be wider, the same width as, or narrower than shoulders; primary retouch usually covers all surfaces, although some plano-convex specimens show minimal modification of the ventral surface; and quality of workmanship seems variable (cf. Reeves 1983b:54-57). The Layer XIV sample

Table 18.4. Besant projectile point measurements arranged by maximum width.

	Maximum Width				Neck Width				Maximum Thickness			
Site	N	Mean	SD	Range	N	Mean	SD	Range	N	Mean	SD	Range
Muhlbach	*	*	*	9-26	*	*	*	7-18	*	*	*	2-9
Old Women's	*	*	*	17-24	*	*	*	14-18	u*	*	*	4-7
Antonsen	148	22.9	2.2	18-29	134	16.1	1.5	12-20	177	6.2	0.9	4-11
Melhagen	55	21.8	2.6	16-28	54	15.3	2.6	5-22	56	5.8	0.7	4-8
Wahkpa Chu'gn	151	21.7	3.2	11-33	*	*	*	*	190	6.0	1.0	3-9
Kenney 8	30	19.1	3.6	13-25	26	14.9	2.3	12-20	29	5.0	1.5	4-7
Sjovold 14	**5**	**17.2**	**2.2**	**13-20**	**7**	**11.9**	**0.7**	**11-13**	**6**	**4.7**	**0.3**	**4-5**
Kenney 6	16	16.3	4.3	13-22	19	12.5	3.4	9-18	23	4.3	1.0	3-5

Notes: N means number of specimens, SD means standard deviation, * means figures are not available from published sources; non-Sjovold figures are from Zeier (1983:3,13), Reeves (1983a), and Ramsay (1991:265).

conforms to these characteristics while showing strong tendencies toward straight bases, "u" shaped notches, and basal widths that are equal to or slightly greater than shoulder widths. One slight difference may lie in breadth to depth proportions of notches which in Layer XIV are closer to 2:1 than the 3:1 found in some Besant samples (cf. Ramsay 1991: 245).

Another basis for comparison is size. Some comparative projectile point measurements from selected Besant sites are shown in Table 18.4. The Sjovold range for thickness falls within the range for reported Besant sites, with the Sjovold mean being toward the lower end of the range. Sjovold widths fall within the range for five other sites — Kenney 6, Kenney 8, Muhlbach and Wahkpa Chu'gn — and overlap the lower quarters of ranges for two other sites. The mean value for Sjovold width is bracketed by means for Kenney 8 and Kenney 6, but is 4 mm smaller than means for Wahkpa Chu'gn and Antonsen. As to neck width, the Sjovold sample falls within the range for Kenney 8, Muhlbach and Melhagen, while overlapping the bottom of ranges for Kenney 6 and Antonsen. Mean Sjovold neck width, however, is smaller than any of the comparative sites. Thus, with only a few fine distinctions, one could say that there is a high degree of comparability between measurements for Sjovold XIV and those of known Besant sites. One Sjovold tendency is to be at the lower ends of Besant ranges. The closest overall comparison is to Kenney 6. Kenney 8 is next closest. Both of these close comparisons are with materials from campsites. Sjovold, of course, is also a campsite.

A technological matter related to size is whether the Sjovold points functioned as dart points, as early forms of Besant projectile points are presumed to have functioned (Kehoe 1974; Reeves 1983b:92), or as arrowheads. Applying the Thomas (1978) discriminant classification equations for darts and arrowheads, we find that three measurable Layer XIV specimens are classed as arrowheads, and two (catnos 6264, 6265) yield results too close for classification. Therefore, the Layer XIV sample does not conform to expectations about the age of bow and arrow technology in the Besant series. If Layer XIV is Besant, then the age of bows and arrows within that series must be greater than previously believed.

A final point of comparison concerns material of manufacture. A chipping stone much favoured by Besant tool makers was Knife River Flint (cf. Reeves 1983b:96; Johnson 1970:65-66; Ramsay 1991:111.) This preference is especially noticeable in sites far removed from the Knife River Quarries in North Dakota, especially at bison kill sites such as Muhlbach (Gruhn 1971), Melhagen (Ramsay 1991) and Richards (Reeves 1983b:96; see also Johnson 1970). Besant projectile points there were 84%, 70% and 97% Knife River Flint, respectively. It turns out that 60% of the Sjovold points are also made of Knife River Flint and the sample, therefore, conforms to the Besant preference.

Identification: given that Sjovold Layer XIV projectile points are similar to Besant projectile points (straight-based variety) in respect to form, size and preferred material of manufacture, we identify them as belonging within the Besant series. Given some unusual attributes such as a date which is several hundred years older than that previously established for initiation of Besant, a sample which is uniformly straight-based, and a sample whose measurements suggest very early use of arrows, we feel that the Sjovold points add sufficient new information about Besant to justify re-examination of straight-based forms throughout the series. We find that, with many minor variations, such forms span the whole Besant series, and are central, in many respects, to its identification. Yet, this type has no name of its own. Accordingly, we propose the new type name, Outlook Side-Notched, after the name of the town nearest the Sjovold site. The Outlook Side-notched type is generally straight-based, that is, the basal edge in planview forms either a straight line or else a slightly concave or convex line in which depth of concavity or the height of convexity does not exceed 1 mm. It has broad "u" or "v" shaped notches, one on either lateral edge. Notches are placed very close to the basal edge and often touch and occasionally even remove 1-2 mm of the basal edge. Edges of the blade are generally slightly convex. In cross-section the points are biconvex or plano-convex. The Outlook Side-notched type spans the Besant series from initiation to demise. Its forms appear in both dart and arrow technology. It is usually the main projectile point type present in Besant sites, although other Besant types such as Bratton Convex-based or Sandy Creek may also be present, as may be the odd corner-notched, tang-shouldered form usually attributed to the Pelican Lake series. The relatively narrow range of basal shapes evident in Sjovold Layer XIV, compared with the broader range of the Outlook Side-notched type, may be an indication of what the type looked like at the time of Besant initiation.

Chipped Stone Debris

The dominant chipping material in Layer XIV, excluding cores, is Knife River Flint at 43.2% by weight, followed by quartzite (26.8%), fused shale (12.5%), petrified wood (10.8%), and traces of quartz, silicified sediment, Swan River Chert, petrified peat, and chert (Table 18.5). One difference between this sample and chipping debris from most other layers is the dominance of exotic materials, specifically Knife River Flint from quarries in North Dakota (Clayton, et al. 1970; Ahler 1986) and fused shale probably from coal burns in southern Saskatchewan or northern Montana and North Dakota

Table 18.5. Chipped stone debris, excluding cores, from Layer XIV.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
chert	1	-	4	5	0.2	-	1.9	2.1
fused shale	11	5	40	56	5.7	1.3	22.0	29.0
Knife River Flint	59	11	59	129	49.3	4.4	46.4	100.1
petrified peat	-	1	4	5	-	0.1	2.7	2.8
petrified wood	-	-	1	1	-	-	25.0	25.0
quartzite	-	1	-	1	-	62.0	-	62.0
quartz	-	1	1	2	-	0.1	3.1	3.2
Swan River Chert	1	1	1	3	0.5	1.4	1.0	2.9
silicified sediment	2	1	1	4	0.9	0.6	1.6	3.1
unidentified	-	-	3	3	-	-	1.5	1.5
Total	74	21	114	209	56.6	69.9	105.2	231.7

(cf. Wettlaufer's [1960:73] baked shale; Fredlund's [1976] Porcellanite; and Clark [1985]). Quartzite and petrified wood, which may be of local origin, are each represented by a single piece of debitage and are not among the materials represented by tools. Meanwhile, Knife River Flint and fused shale are dominant not only as chipping materials, but also as materials among recovered tools. Some other materials such as chert, Swan River Chert and silicified sediment, whose sources could be either local or exotic, represent only a trace among the debitage, but were each also represented by tools.

Degree of reduction offers additional information about activities. The single pieces of quartzite (62.0 g) and petrified peat (25.0 g) are anomalous for their large size and scarcity. Medium-size pieces (average weight 1.0-2.9 g) are in nearly as short supply. Two pieces of quartz weigh an average of 1.6 g and three pieces of Swan River Chert, 1.0 g. Small pieces of debris are most numerous in Layer XIV. Knife River Flint averages 0.8 g, silicified sediment (0.8), petrified peat (0.6), fused shale (0.5) and chert (0.4). Two overarching inferences may be drawn from observations on the chipped stone debris: (1) the great majority of chipping materials were carried to the Sjovold site from a considerable distance to the south; and (2) most chipping involved finer phases of reduction such as would be required for refurbishment of broken tools. One medium-size chipped stone core (catno 6559) was recovered in XU 4. It is a bipolar core of coarse white Swan River Chert weighing 147.7 g.

Bone Tools

Six bone tools include a chopper bit, two pressure flakers, a hide grainer, and two awls (see Figs. 4.1, 18.5). The bit of a chopper made on a large mammal long bone fragment was recovered from XU 6 (catno 6638; Fig. 18.5d).

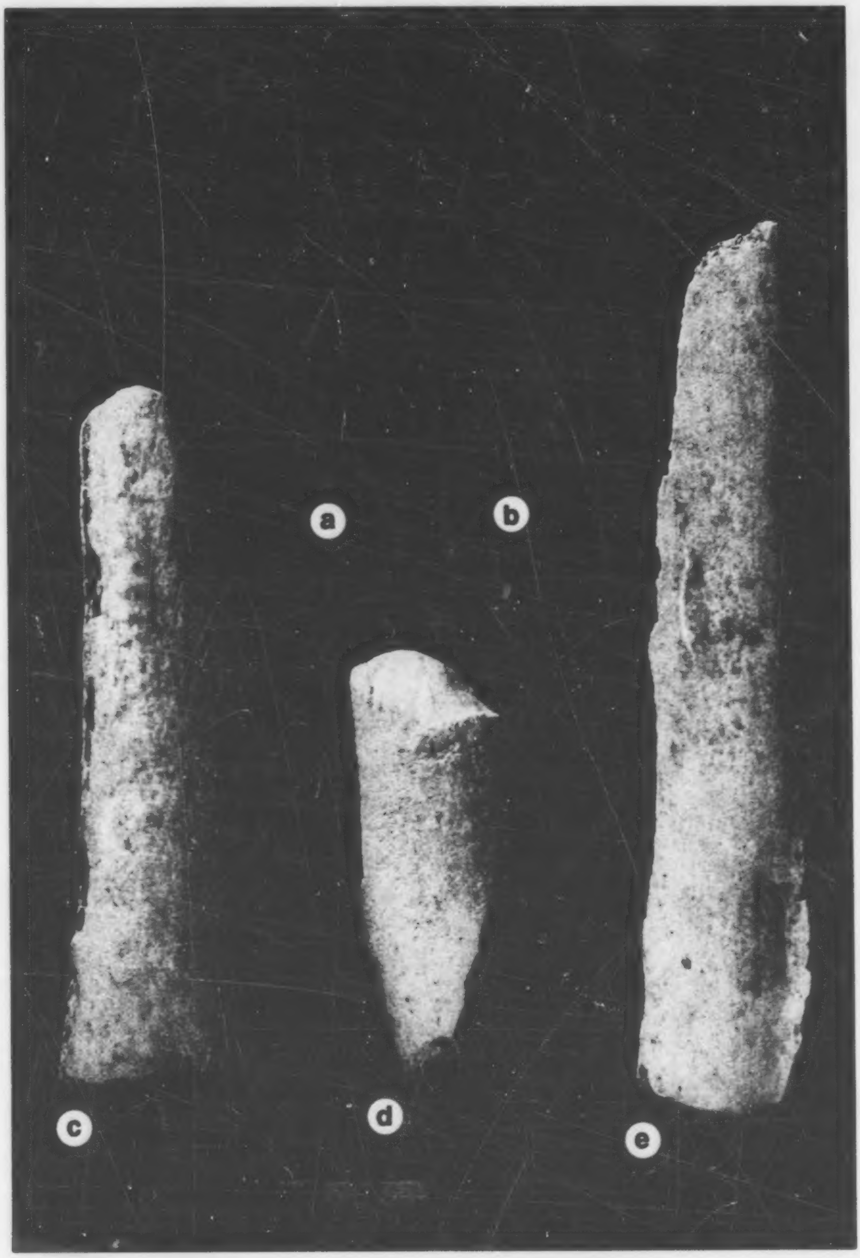


Figure 18.5. Bone awls (a-b), pressure flakers (c, e) and a chopper bit (d) from Layer XIV.

Two pressure flakers made on bison rib fragments were found in F14-c (catnos 6572, 6517; Fig. 18.5c, e). They are unusual in that the working tips are on opposite ends of a long rib shaft that can be conjoined at a fresh-state fracture on the unworked ends. It is unlikely that they comprised a single double-ended flaker, because such a tool would have been very unwieldy. The existing pieces measure 145 mm and 120 mm, respectively, and these are optimum lengths for such tools. They may have been discarded because their working tips collapsed during use. One of the tip appears to have been oblique in outline and flat in section, while the other was rounded in both perspectives.

XU 6 yielded a bison left distal metatarsal (catno 6470) that has had moderate use as a hide grainer, producing an anterior/lateral bevel on the tool (see Fig. 4.1).

A large mammal rib from XU 6 (catno 6187; Fig. 18.5b) appears to have been used as an awl, although it lacks any sign of deliberate shaping on the naturally sharp point. It is 68 mm long with polish extending 12 mm from the tip, but no striations are observed. An unclassifiable splinter from hearth F14-a (catno 6349; Fig. 18.5a) has been shaped and used either as an awl or as an uneyed needle. It is very slender and delicate, 69 mm long, with polish extending 25 mm from the tip and londitudinal striations visible on islands of the original bone surface that have not been etched by rootlets.

Faunal Remains

A radiocarbon sample (S-2060) weighing 290 g was removed from the contents of hearth F14-a. The remaining bone is shown in Table 18.6.

Bison, NISP=112: see Table 18.7. Four dental age groups are represented among these remains. A right maxilla containing dP^4 is the youngest bison assigned to an age group (A) in this analysis, and it belonged to a calf about 0.6 years old. An older calf, perhaps a year older, is revealed by upper and lower teeth belonging to age group B, and adult dentitions can be referred to at least two age groups. Post-cranial elements belong to both the cow/calf group (MAU=1.5) and adult bull (MAU=0.5). The bull carpals and tarsals are the largest examples found in the site. Most of the elements listed as cow or calf are large enough to be from adult cows and therefore cannot be from calves as young as age groups A and B. In addition, a left distal humerus is intermediate in size between cow and bull, and it probably represents a subadult bull. Hence it appears that small portions of many bison have contributed to this faunal assemblage.

The mandible sample is large enough to exhibit redundancy in fracture patterns (Fig. 5.4). Symphyses are separated by fractures through diastema, and the placement of cut marks on and adjacent to fracture surfaces shows that this process was directed toward removal of the tongue. Cut marks near the posterior border of the ascending ramus reflect slices that would have aided the opening of the jaw in order to fracture the ramus between the articular condyle and the angle of the

Table 18.6. Vertebrate remains from Layer XIV.

	Number				Weight			
Size, Taxon	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
6, Bison	35	28	49	112	1,226.6	2,318.9	1,993.8	5,539.3
6, Wapiti	-	-	3	3	-	-	11.7	11.7
5-6, mammal	70	29	74	173	384.4	156.8	552.3	1,093.5
5, Deer or pronghorn	-	1	-	1	-	0.4	-	0.4
4, Lynx	1	-	-	1	0.7	-	-	0.7
3, Rabbit or hare	-	-	1	1	-	-	0.1	0.1
3, mammal	1	4	-	5	0.1	0.4	-	0.5
-, mammal	1,162	532	603	2,297	476.2	201.1	308.0	985.3
Bird,	-	-	1	1	-	-	0.1	0.1
Total	1,269	594	731	2,594	2,088.0	2,677.6	2,866.0	7,631.6

mandible, thereby freeing the lower jaw from the skull. Mandibular corpus fragments are further reduced through removal of the lower border, presumably to gain access to the pulp cavity. Impact marks on humerus, radius, metacarpal, and femur shafts reflect fracturing for marrow retrieval. Cut marks on humerus and tibia shafts probably represent defleshing. Many of the bison bones were found in hearth fill, but only one of them (a tympanic bulla fragment) is charred. For example, hearth F14-a yielded 12 bison elements, and hearth F14-b contained nine specimens. Nine bison elements occurred in the debris cluster (F14-c).

Carnivore gnawing is seen on a rib end, a distal scapula, the juvenile scapula blade, and one innominate; all of these represent blood-rich, thin-walled areas. One sesamoid has been gnawed by a rodent, and another has been digested, presumably by a carnivore. Only a few bones exhibit weathering, but five of these are weathered to Stage 2. Rootlet etching is more common, but only three bones reached a moderate stage of etching.

Wapiti, NISP=3: M_1, two $M_?$ fragments. All three specimens were found in hearth F14-a.

Size 5-6 mammal, unidentified, n=173: 18 cranial, 36 tooth, two vertebra, 34 rib, two scapula, one humerus shaft cylinder, 80 long bone shaft fragments. Cut marks are present on four long bone and two rib fragments. Of six charred specimens, five occurred in hearth F14-a. Tooth marks were left by carnivores on two long bone and two rib fragments, and one rib fragment has been digested. The humerus is so small and so poorly ossified that it probably represents an artiodactyl fetus.

Deer or Pronghorn, NISP=1: $I_?$. Although complete, this incisor could be from a pronghorn or a deer.

Lynx, NISP=1: 3rd phalanx. This bone was found in hearth F14-b.

Table 18.7. Bison elements and fragments from Layer XIV.

Element	NISP	MNE	Calf	Cow or Calf	Cow	Bull
Tympanic bulla	3	3	-	-	-	-
Horn core	3	3	-	-	-	-
Maxilla[a]	11	5	2	-	-	-
Mandible[b]	19	4	1	-	-	-
Hyoid	1	1	-	-	-	-
Thoracic spine	1	1	-	-	-	-
Rib	5	5	-	-	-	-
Scapula	4	3	1	1	-	-
Humerus	9	3	-	1	-	-
Radius	9	7	-	3	-	1
Ulna	6	4	1	-	-	-
Intermediate carpal	1	1	-	1	-	-
Ulnar carpal	1	1	-	-	-	1
Carpal 4	1	1	-	-	-	1
Accessory carpal	1	1	-	-	-	-
Metacarpal III+IV	3	3	-	2	-	-
1st phalanx	3	3	-	1	-	2
Innominate	6	3	-	-	-	-
Femur	5	4	-	-	-	-
Tibia	5	4	-	2	-	1
Lateral malleolus	1	1	-	1	-	-
Tarsal C+4	1	1	-	-	-	1
Tarsal 2+3	1	1	-	-	-	1
Metatarsal II	1	1	-	-	-	-
Metatarsal III+IV	2	1	-	-	1	-
Sesamoids	9	9	5	-	-	-

a. one maxilla in age group A, one in age group B?, two in age group 4-6, one in age group 7. b. one mandible in age group B, one in age group 6?

Rabbit or Hare, NISP=1: metacarpal II. This is an immature specimen, missing its distal epiphysis.

Size 3 mammal, unidentified, n=5: five long bone shaft fragments. One occurred in hearth F14-b, and two XU 5 have been digested. They probably represent a rabbit or hare.

Unidentified mammal, n=2297: fragments of which only 37 (4-8 cm) are more than 4 cm long. Of 240 charred and 292 calcined fragments, about half occurred in the two large hearths (F14-a, F14-b), and the rest were scattered. Likewise, digested fragments were scattered across all excavation units, and some occurred in hearth fill.

Table 18.8. Modified vertebrate remains from Layer XIV.[a]

Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Fracture States Recent	Dry	Fresh	Whole	Total
6, Bison	7	1	5	1	17	96	13	-	25	59	15	112
6, Wapiti	-	-	-	-	-	3	3	-	-	-	-	3
5-6, mammal	6	6	4	1	*	*	36	-	17	120	-	173
5, Deer or Pronghorn	-	-	-	-	-	1	1	-	-	-	-	1
4, Lynx	-	-	-	-	-	1	-	-	-	-	1	1
3, Rabbit or Hare	-	-	-	-	-	1	-	-	-	-	1	1
3, mammal	-	-	-	2	-	2	-	-	-	5	-	5
-, mammal	1	532	3	139	*	*	-	*	*	*	-	2,297
Bird	-	-	-	-	-	-	-	-	-	1	-	1

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

Unidentified bird, n=1: distal coracoid fragment. This specimen is similar in size and conformation to a Passenger Pigeon (*Ectopistes migratorius*), but it is too fragmentary for a positive identification.

Plant remains: A small sample of charcoal (16 pieces, 1.4 g) was collected from hearth F14-a.

Discussion. Parts of at least two bison calves and several adults are represented in Layer XIV, and one element suggests the presence of an additional subadult bull. The calf in age group A indicates an autumn season of occupation, and this would be compatible with the possible ages of the group B specimens but not with the unidentified fetal artiodactyl bone. The latter, regardless of species, would normally indicate a late winter or early spring season, but it could be from an out-of-season pregnancy. The bison remains are extensively processed, with fairly abundant evidence of dismemberment, filleting, and fracturing for marrow. The bones were also used to manufacture a variety of tools. It is interesting that the axial skeleton is greatly under-represented in this layer; other than two unidentifiable vertebra fragments, the only piece of the backbone is a thoracic neural spine that could have been brought to the site in near-filleted hump meat.

Not only the bison bones, but also the wapiti, lynx and one size 3 mammal specimen are associated with hearth features. These animals may have supplemented the diet or provided other materials such as hides.

In contrast with Layers X-XIII, digested bone fragments are abundant and are scattered across the excavated area. This pattern may reflect the timing of carnivore gnawing in relation to the human occupation. If carnivores scavenged the remains after abandonment by human occupants, they may have been less inhibited in excreting digested bone fragments in the midst of campsite debris. Both subaerial weathering and rootlet etching are less advanced in Layer XIV than in several layers just above it. This implies a shorter surface-residence time and possibly a more rapid sedimentation rate.

Interpretation of Layer XIV

As with most Sjovold site occupations, the focus of attention in Layer XIV falls on surface hearths, in this case two hearths situated about 3.5 m apart and about a meter north of the present creek bank. These hearths were a little different from others in the site. They were wood-fuelled and contained fire-broken rocks in a moderate state of disaggregation together with a sample of other debris indicative of a variety of fireside activities. All of this shows that the burning lasted for at least an hour and likely for several hours. Yet, both hearths were underlain by subsurface soil scorching only 1-2 cm thick. We speculate that this can be explained as a consequence of a special method of hearth construction, one which was designed to compensate for damp, frozen or snow-covered ground. Specifically, we hypothesize that a layer of wood was laid on the ground as a hearth site(s) and that a fire was built on top of it. This would provide a platform upon which a campfire could have been well-started and kept burning even though underlying soil was soggy at the start or became soggy when heat melted a snow-covered or frozen surface. Such a bed of material would have insulated the underlying soil from the fire's heat for a time, even though the bed would have been consumed eventually. When that occurred the subsoil would have been dried out and would start to be scorched. This unusual type of hearth alerts us to the notion that the site was probably occupied during inclement weather. It is interesting to note that there were two hearths, that they were within 3.5 meters of one another, and had similar characteristics. We believe that they were contemporary with one another. Since they seem to have served similar functions, we presume that the presence of two hearths is related to the size of the party occupying Layer XIV. If a minimum of two people were at each hearth, then at least four people used the small area exposed in our excavations.

Scatters of charcoal to the southeast of both hearths are evidence for a northwest wind during the occupation. A noticeable scarcity of occupation debris within the charcoal scatter areas suggests that the charcoal was probably scattered during operation of the fires and that heat and windblown embers may have made areas southeast of the hearths uninhabitable. Thus, it appears that the fires were built in open air or, at best, in a partly sheltered situation.

Subsistence for the occupants of Layer XIV was based mainly on bison. Broken bones of at least two calves and several adults were found in and near the hearths. The bison remains were extensively processed with abundant evidence for dismemberment, filleting, fracturing for marrow and manufacture into tools. Heads and limbs are fairly well represented among the broken bones while spine and thorax are very lightly represented. This may indicate that the animals were killed and butchered at some distance from this campsite and that only certain butchering units were carried or dragged back to camp. A few wapiti, rabbit and lynx bones were included suggesting a supplement to the bison diet and perhaps also procurement of furs for clothing. Other local resources used by Layer XIV occupants included surface rocks for firestones, anvils and hammers. These were gathered from the creek or river beds or from the nearby valley slopes and their presence indicates that at least parts of those surfaces were exposed to view at the time of occupation, a situation which is possible even during some parts of winter.

Activities carried out in or near the hearths included: heating and reheating rocks, presumably mainly for stone-boiling; assembling fired rocks a short distance north of the hearths for use as roasting beds and as anvils for bone breaking; breaking bones for marrow and for tool material using fired rocks as anvils and small slabs of limestone as hammers; disarticulation of joints of meat using biface stone knives; cooking and consumption of game; rejuvenation and/or replacement of at least 10 chipped stone projectile points; scraping of at least one hide with a small chipped stone endscraper; cutting soft materials such as meat, hides or sinew using small stone flake knives; disposal of part of the debris especially broken tools, but also some chipped stone and broken bone, into the hearths; leaving other debris, mainly bone fragments, among the fireside rock cluster(s) used for roasting and breaking bones; and tossing medium and larger pieces of bone and fired rock debris into an open area between and to the south of the hearths. Prime sitting places were probably on the north sides of each hearth.

The duration of occupation would seem to have been on the order of several hours to several days. It was long enough to achieve a moderate degree of disaggregation of firestones, to prepare and consume parts of several bison, to do a bit of hide scraping and tool repair. It is hard to imagine that all the animals represented by bones were killed in one hunt. Therefore, either the party was large enough to include several hunters, or hunting was spread out over several days. It does not appear that the occupants relied on an enclosing shelter though they may have erected a lean-to or windbreak north of the hearths. The presence of approximately seven month old calf bones among the bison remains suggests that the season of occupation was early winter.

The identity of Layer XIV occupants can be expressed in several ways. In terms of gender, there is a strong indication of adult male presence in the projectile points and the bison, wapiti and lynx remains. The hide scraping and cutting tools and are suggestive of adult female activity, while the rabbit remains could be an indication of either juvenile or adult trappers. Thus, though male expression is strongest, there is reason to suspect that this was a mixed party of males and females, adults and sub-adults. As to their place of origin, we suspect that this party was native to a region which lies several hundred kilometers southeast of the Sjovold site since the majority of both chipped stone tools and chipping debris reflects materials derived from sources in those areas. Reasons for southern Saskatchewan or Middle Missouri bison hunters to undertake a journey far to the north of their usual haunts might include special missions for hunting, visiting, war or trade. Given the evidence for a leisurely occupation, a mixed party and the variety of game, we suspect that hunting was a key motive.

As to archaeological identity, we propose that Layer XIV materials represent a very early phase of the Besant series. We also propose a new type name, Outlook Side-notched, for the small straight-based points found in Layer XIV hearths. It is interesting to note that these points were mainly arrowpoints. This finding contradicts speculation by other archaeologists to the effect that bow and arrow technology appeared only at the end of the Besant time span, around AD 400 (Kehoe and Kehoe 1968; Kehoe 1974; Reeves 1983b). Our estimate for the age of occupation is 850-550 BC (cal 2800-2500 BP; Table 3.6), an estimate based on radiocarbon dates within Layer XIV and in Layers XII (above) and XVI (below). Such an age estimate correlates with the earliest appearance of Woodland (ceramic) cultures on the eastern edges of the central and northern Plains which some authors date to about 2600-2900 BP (Chapman 1980; Gregg 1987). It has been proposed, and we agree, that the Besant series may represent a fusion of Woodland traits with a pre-existing Plains bison hunting technology (Kehoe and Kehoe 1968; Reeves 1970, 1983b; Johnson 1970, 1977; Dyck 1983). Sjovold Layer XIV does not contain ceramics. However, one would not expect ceramics in a mobile winter hunting camp situated outside home territory. Indeed, although some Besant sites contain pottery (cf. Johnson 1977; Dyck 1983) many do not, a fact attributable to extremes in mobility, weather and landscape accompanying the northern Plains bison hunting lifestyle. Some combinations of these variables are conducive to the production of ceramics while others are not (cf. Arnold 1985). Thus, the absence of ceramics in Layer XIV does not contradict its identification as Besant.

A final point concerning Layer XIV relates to site location and age. Sjovold Layer XIV is the oldest Besant manifestation recognized to date. It lies a little north of the known center of Besant distribution (Reeves 1983b:93). Thus, if Besant did originate in the eastern or southeastern part of its range, it also spread quickly into this central region.

Interlayer XIV/XV

Features: there was one small surface hearth, F14/15-a, within the deposits of Interlayer XIV/XV. Most of it was removed by our excavations but a small portion remains *in situ* just beyond the south edge of XU 4. Its center point was approximately at 177s133w. It was about 272 cm BS, and was roughly circular, about 55 cm in diameter, and had a flat to very slightly dished profile 1-2 cm thick. F14/15-a consisted mainly of reddish-brown earth. It was easy to see against the surrounding yellow-buff silty matrix. No soil horizon was evident in excavation profiles at an equivalent level, although there were a few pieces of fire-broken rock, bone and chipping debris (mostly Knife River Flint) at about the same level in XUs 4 and 5.

Rock (Table 18.9): dominant coarse rock materials in the interlayer are granite (36.3%), quartzite (15.5%), gneiss (15.0%), limestone (13.2%) and grano-gneiss (10.5%). These figures are similar to those for Layer XIV except for the higher proportions of limestone and quartzite. The average weight is 40.8 g, about 20% smaller than the average weight for Layer XIV. Except for the limestone and a few pieces of quartzite, the great majority of interlayer rock showed signs of having been fired.

Table 18.9. Coarse rock from Interlayer XIV/XV.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
andesite	4	-	-	4	375	-	-	375
basalt	1	-	-	1	1	-	-	1
concretion	-	-	1	1	-	-	59	59
gneiss	10	-	1	11	860	-	22	882
granite	51	20	2	73	2,092	1	41	2,134
grano-gneiss	2	1	-	3	614	2	-	616
limestone	5	1	-	6	769	4	-	773
quartz	1	-	-	1	2	-	-	2
quartzite	10	-	-	10	912	-	-	912
sandstone	3	-	-	3	22	-	-	22
shale	-	1	-	1	-	*	-	0
unidentified	26	3	1	30	27	2	73	102
Total	113	26	5	144	5,674	9	195	5,878

Stone Tools: there was one MURL in the interlayer (see Fig. 18.6). Catno 6692, a 47 mm long flake of Knife River Flint, was recovered in XU 4 at the level of the trace occupation (max width 29 mm, thickness 5 mm, weight 6.6 g). It is unifacially retouched along the distal three quarters (33 mm) of its thickest side (maximum thickness of 2.5 mm). The retouched edge is slightly convex in plan and slightly convex in profile. Retouching becomes smaller and more irregular along the thin distal third of that edge and trails off into occasional nicks which continue onto the thin distal end of the flake. It appears that the main retouching was freshly done about the time the object was lost. There does, however, appear to be a light polish over the flake scars right at the edge and extending up to about 1.5 mm away from the edge. Most cracks or crevices across both faces contain traces of a powdery white substance, apparently calcium carbonate. Particles of granular reddish residue, presumably blood, may be seen on the dorsal face of the unretouched proximal portion of the modified side and also on the thinnest sharpest portions of the opposite (unretouched) edge. Though the steepness of the central part of the retouched edge (about 45°) might lead some to attribute a scraping function to this tool, our guess is that its main use was for cutting a soft bloody object such as meat and that both edges served this use.

Chipped Stone Debris (Table 18.10): there were 50 pieces of chipping debris (no cores) in the interlayer. Material proportions (by weight) resemble those of Layer XIV in respect to high percentages for Knife River Flint and quartzite, however, fused shale is much lower and silicified sediment is much higher.

Bone Tools: A bison rib from XU 5 (catno 6754) has been shaped and used as a tool It is classified as a pressure flaker, but it is unique among the flakers in having a slightly polished facet on the working end. At 194 mm it is also the longest of the flakers, and the working tip is rounded

Table 18.10. Chipped stone debris from Interlayer XIV/XV.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
chert	-	1	-	1	-	3.0	-	3.0
jasper	-	2	-	2	-	0.6	-	0.6
Knife River Flint	2	6	-	8	0.7	2.5	-	3.2
quartz porphyry	1	-	-	1	106.5	-	-	106.5
quartzite	2	-	1	3	98.6	-	6.1	104.7
quartz	5	-	-	5	4.1	-	-	4.1
Swan River Chert	1	-	-	1	0.1	-	-	0.1
silicified sediment	1	28	-	29	0.8	72.1	-	72.9
Total	12	37	1	50	210.8	78.2	6.1	295.1

in outline and beveled toward the medial surface of the rib.

A bison left distal metacarpal from XU 4 (catno 6686) has been used as a hide grainer, producing a slight degree of wear on an anterior/medial bevel.

Faunal Remains:

Bison, NISP=16 (694.6 g): premaxilla, mandibular diastema, I_2, thoracic prezygapophysis, five ribs, humerus shaft, a complete radius ♀/©, proximal radius, distal metacarpal ♂, femur shaft, 3rd phalanx, proximal medial sesamoid. The complete radius lacks its distal epiphysis; therefore, it represents a bull less than five years old or a cow less than six. There is a cut mark on the ventral surface of the premaxilla, and a rib exhibits cut marks that may represent defleshing. Three bones are weathered to Stage 1, and 14 are superficially etched by rootlets.

Size 5-6 mammal, unidentified, n=50 (283.3 g): 22 cranial, three tooth, eight rib, one scapula, 16 long bone shaft fragments. Half of the bone fragments were fractured when fresh, and two ribs exhibit multiple cut marks that may represent defleshing. Two other ribs and the scapula fragment are marked by carnivore tooth punctures.

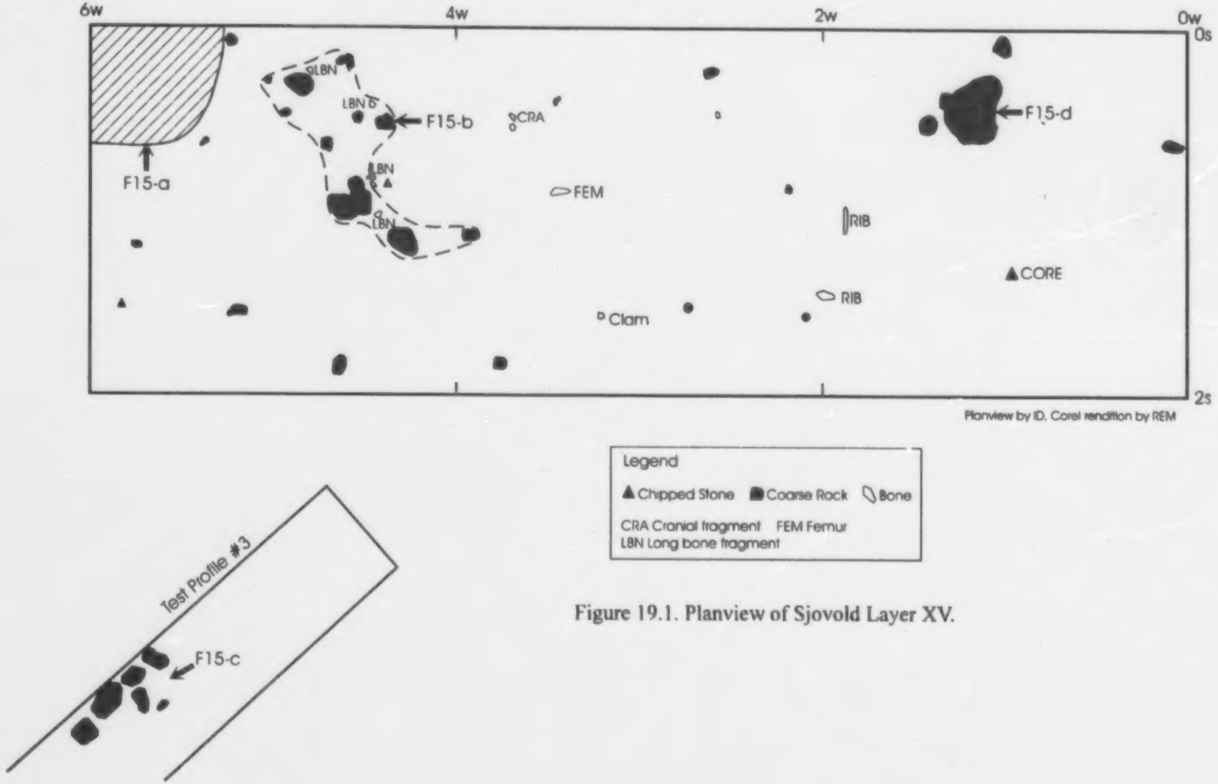
Wolf or Dog, NISP=2 (53.3 g): maxilla with all alveoli and containing I^3, P^1, and P^4-M^2; cuboid, both from XU 4. Measurements show that the maxilla could represent either a large dog or a small wolf (Fig. 5.3). It is interesting that the zygomatic arch exhibits multiple incisions that might have resulted from skinning or defleshing. Both specimens are superficially etched by rootlets.

Ground Squirrel, NISP=1 (0.1 g): mandibular symphysis, from XU 4. This bone was fractured when fresh, but it lacks rootlet etching, suggesting the possibility that it is intrusive through a burrow.

Unidentified mammal, n=562 (246.7 g): fragments less than 6 cm in length. Of 44 burned specimens, 30 are charred and 14 are calcined. Of 18 digested fragments, 16 occurred in XU 5 and may be the contents of a scat.

Discussion. These remains could be added to Layer XIV without increasing the bison count, but the canid remains probably belong with the canid bones in Layer XV.

Interpretation of Interlayer XIV/XV: These deposits contain a mixture of materials from Layer XIV, from a very sparse occupation between layers XIV and XV, and possibly a few items from the top of Layer XV.


6w
4w
2w
0w
0s
2s
F15-a
LBN
LBN
F15-b
LBN
LBN
CRA
FEM
Clam
RIB
RIB
F15-d
CORE
Test Profile #3
F15-c
Legend
Chipped Stone
Coarse Rock
Bone
CRA Cranial fragment
FEM Femur
LBN Long bone fragment

Planview by ID. Corel rendition by REM

Figure 19.1. Planview of Sjovold Layer XV.

Chapter 19

Layer XV: Buffalo Stew and Pelican Eggs

Introduction and Planview

Layer XV began at a depth of 280 cm BS and continued to about 288 cm BS at 0n2w, the surface of the occupation floor being at about 283 cm BS. One small boulder projected upward some 15 cm, but most artifacts lay flat on the occupation surface which seemed almost level. The layer contained four features, some chipping debris and a fair bit of fragmented coarse rock and bone, but no chipped stone tools. The cultural identity is unknown. Age is interpolated to be between 950 and 650 BC (cal 2900-2600 BP; Table 3.6). Interlayer XV/XVI was 13 cm deep and contained very little cultural material. We screened the interlayer deposits to a depth of 5 cm. The handful of items found immediately below Layer XV are included with those reported for XV. The middle 6 cm of the interlayer was discarded without screening. The single item recovered by screening the bottom 2-3 cm is a small piece of limestone weighing less than 0.5 g.

In addition to the four features, the Layer XV planview (Fig. 19.1) shows the locations of one core, two bison ribs and a femur, some unidentified size 5-6 mammal cranial and long bone fragments, and a fragment of freshwater clamshell.

Features

Feature F15-a (Fig. 19.1, Table 19.1), a surface hearth, was partly exposed in the northwest corner of XU 6. The hearth had two layers, a surface zone of greyish black ash-laden soil, about 1-2 cm thick, and an underlying lens of brownish grey soil also 1-2 cm thick. Differences between the hearth layers were fairly easy to see in profile. In addition to greyer colour, the upper layer was distinguished by its heterogeneity. It contained a mixture of combustion remains, soil, and fragmented bone and stone. The underlying layer was simply a compact soil, colour-altered, but otherwise undisturbed. The contact between the two parts of F15-a formed an undulating line with undulations apparently due to the gouging of shallow holes or grooves on the subsoil and infilling from the upper layer. In the part we excavated the upper layer contained 252 fragments of coarse rock weighing 475 g. The majority was granite and much of the rest, unidentified, had grano-gneiss characteristics. Most of the rock was clearly fire-broken. The upper part of the hearth also contained 12 pieces of chipping debris (11 quartz and one Knife River Flint) weighing 97.9 g, together with 110 bone fragments, 53 of them burned. Pieces of carbonized wood were not recovered although photographic records indicate that a few pieces may have been present.

Table 19.1. Features in Layer XV.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F15-a	surface hearth	25s575w	>65	>70	4
F15-b	fired rock cluster	65s455w	110	115	8
F15-c	fired rock cluster	335s587w	>53	>55	10
F15-d	boulder cluster	43s118w	60	50	17

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

F15-a was speckled with bits of a white substance which we presume was calcium carbonate. The speckles extended across the adjoining occupation surface and we do not think that there is a connection with the fire. The most evident cultural material near F15-a was an open scatter of coarse rock fragments, F15-b, beginning about 25 cm from the east edge and extending to the southeast. Other nearby debris tended to be well scattered and quite sparse.

We do not know what fuel was burned in F15-a. Our suspicion is that it was mainly bison dung. Charred wood was absent or very sparse, ashy soil was fairly abundant, and the subsurface burn was shallow, all signs of a bison dung fire. The hearth served as a place for rock heating. It contained many small fragments of fired-rock, pieces which were in an advanced state of disaggregation and indicative of repetitive cycles of heating, removal and reheating. A likely cause is repeated use for stone-boiling. The grooves at the top of the hearth's subsurface were likely due to poking, positioning and retrieval of the heated rocks with sticks. A second function served by F15-a was as a disposal area for chipping and bone debris. Similar debris was also scattered outside but nearby. Our inference is that bone breaking and stone chipping took place near the fire and that some of the debris was dumped or tossed into the fireplace.

Feature F15-b was an open cluster of 14 large, medium and small rocks weighing about 5,500 g. Most were granite or gneiss. All showed evidence of firing. The rocks occupied an irregular area measuring about 1.25 m by 0.5 m. The feature was oriented northwest to southeast with the north end about 25 cm east of F15-a. Among the rocks were a few fragments of bone. A few more fragments of bone and a couple of pieces of shell were scattered a short distance further east and southeast. Our guess is that F15-b was a discard or holding area for fired rock which had been used to heat fluids in a boiling or simmering vessel, and that the vessel was situated nearby, possibly just to the west or just to the east of F15-b. There was no trace of the hypothesized vessel other than the presence of F15-b. Some kinds of boiling vessels are known to have been built above ground using only four sticks and a hide (cf. Wissler 1934:77), and if such a vessel used here was used here it could be expected to have left little trace on the space it covered.

Feature F15-c was another cluster of fired rocks that was partly exposed in a test profile we cut along the creek bank about 3 m south of hearth F15-a. Six large and medium-size fired rocks were revealed by our excavations. The part we saw contained rocks resting on unmodified occupation surface with a few bone fragments several centimeters to the south. It seems likely that F15-c was the discard or holding area for a second boiling vessel.

Feature F15-d consisted of a small boulder (about 6,000 g) resting on and beside four medium-size pieces of rock. Directly beneath it were pieces of well charred wood in alignments forming segments of two branches or large twigs. There was no other charcoal or ash under or near the boulder and no clear sign that underlying soil had been heated. The boulder was granite or gneiss and its natural white-grey cortex, particularly its uppermost surface, appears to have been unmarked. (The boulder was discarded in the field after photography and planviewing on the assumption that it was unmodified.) Three rock fragments below it are all fire broken grano-gneiss. A mid-size fragment situated 5 cm west of the boulder was also fire broken gneiss. It was completely disaggregated into a mass of particles 1 cm or smaller. The slightly outlying rock on the north edge of the feature was a medium-size end fragment of grey-white quartz cobble, probably the same material as chipping debitage found in and around hearth F15-a. There was nothing else around the F15-d cluster for a distance of about 60 cm. A few stone and bone fragments lay 60-100 cm southeast and one medium-size rock lay about 90 cm to the east. Thus, the feature seemed to sit in isolation.

F15-d is difficult to interpret. One possibility is that the boulder served as an anvil upon which something was pounded. That idea is based mainly on size and solidness. However, there is no other supporting evidence; no marks on the upper surface and no small debris around the base. Another idea, one we prefer, is that the cluster, excluding the outlying quartz piece, served as hot rocks for a sweat bath. The smaller pieces at the base certainly show signs of intense exposure to fire. According to this interpretation the boulder would have been heated and perhaps carried to the feature on a couple of branches or a sling made of wooden withes. This would account for the alignments of charcoal under the boulder. It would also account for the absence of material on the surface immediately surrounding F15-d. That space could have served as the (enclosed) seating area. The quartz cobble fragment on the north edge of F15-d is not integral to this interpretation. It may simply have been tossed there, from hearthside at F15-a, before or after the sweat bath was used.

Rock

The figures in Table 19.2 include all coarse rock from XUs 4-6, but not the rocks from test profile 3 (feature F15-c) which were discarded during excavations. That proviso in mind, one might note that granite, grano-gneiss and gneiss (especially with inclusion of the F15-d boulder shown in Table 19.2 as unidentified) were far and away the dominant coarse rocks in Layer XV. Almost all of these materials were situated within four features and were used as heated rocks for cooking and possibly for a sweat bath. The small amounts not accounted for in this way were either a natural part of the soil or were fired rocks lying outside the features.

Table 19.2. Coarse rock from Layer XV.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
andesite	-	-	1	1	-	-	29	29
chert	1	-	1	2	7	-	75	82
gneiss	-	3	6	9	-	52	1,223	1,275
granite	6	4	199	209	52	500	3,894	4,446
grano-gneiss	4	1	33	38	1,515	53	1,426	2,994
greywacke	1	-	-	1	16	-	-	16
limestone	1	1	9	11	3	1	13	17
quartz	-	-	5	5	-	-	12	12
quartzite	-	-	4	4	-	-	60	60
unidentified	12	1	120	133	6,027	31	170	6,228
Total	25	10	378	413	7,620	637	6,902	15,159

Table 19.3. Chipped stone debris, excluding cores, from Layer XV.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
fused shale	1	-	-	1	0.5	-	-	0.5
Knife River Flint	-	-	1	1	-	-	0.9	0.9
petrified peat	-	-	1	1	-	-	5.0	5.0
petrified wood	-	-	3	3	-	-	11.6	11.6
quartz	2	-	32	34	646.2	-	265.5	911.7
Swan River Chert	1	-	-	1	0.4	-	-	0.4
Total	4	0	37	41	647.1	0.0	283.0	930.1

Chipped Stone Debris

Quartz, with 90.2% of the total weight, is the dominant chipping material in Layer XV (Table 19.3). Most of it is attributable to one medium-size cobble of grey-white, coarse grained material. There were also traces of other chipping stones such as fused shale, Knife River Flint, petrified peat, petrified wood, and Swan River Chert, including two cores. Both are of medium size, bipolar type and were found in XU 4. Catno 6861 (Fig. 19.2a) is petrified peat and weighs 27.1 g; catno 6911 (Fig. 19.2b) is Knife River Flint and weighs 53.6 g. The unusual quartz bias may reflect a sampling problem. No quartz tools were found, a large part of the raw material was discarded almost untouched, and most of the quartz chipping debris is flake/shatter or crude flakes. Moreover, traces of other chipping stones of much higher grade show that site occupants were present. Layer XV stone chipping may truly have been very limited, but it is also possible that most chipping activities occurred in another part of the site.

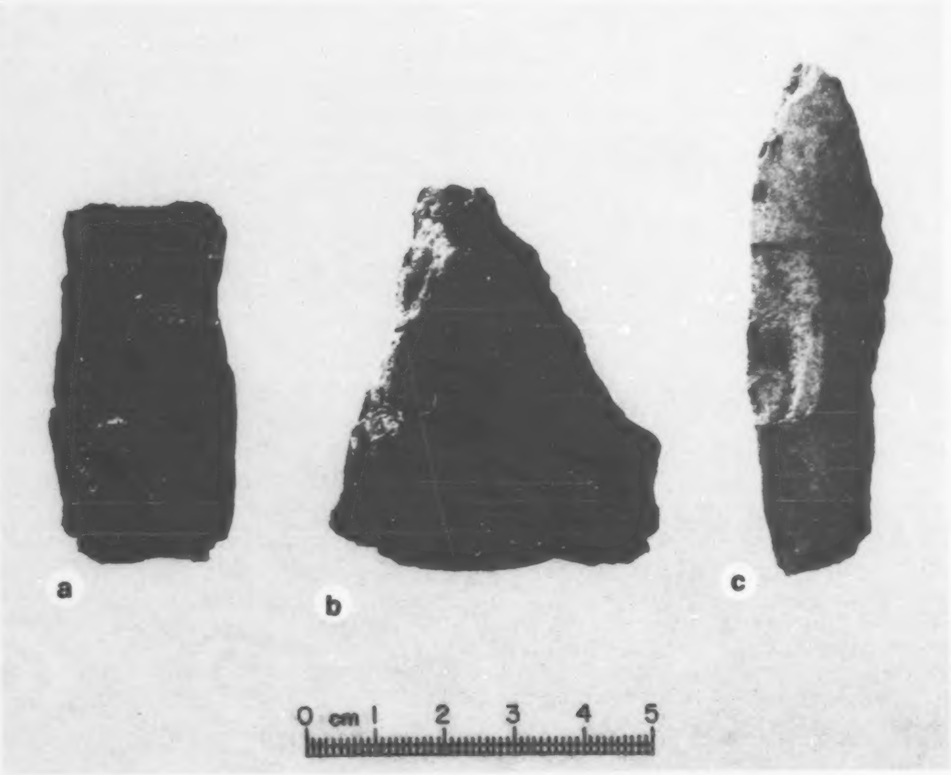


Figure 19.2. Chipped stone cores (a-b) and a bone chopper bit (c) from Layer XV.

Bone Tools

One chopper bit made on a size 5-6 mammal long bone fragment was found in XU 6 (catno 6926, Fig. 19.2c).

Faunal Remains

Bison, NISP=8: five ribs, humerus shaft, two femur shafts. One rib bears multiple cut marks on both the medial and lateral surfaces. All were fractured when fresh, and the humerus and one femur fragment exhibit well preserved impact scars.

Table 19.4. Vertebrate remains from Layer XV.

	Number				Weight			
Size, Taxon	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
6, Bison	3	3	2	8	58.9	50.9	83.5	193.3
5-6, mammal	3	3	26	32	1.0	18.3	148.4	167.7
4-5, Wolf, Dog or Coyote	2	-	-	2	1.1	-	-	1.1
4-5, mammal	-	1	-	1	-	1.1	-	1.1
3, mammal	-	-	1	1	-	-	0.2	0.2
-, mammal	71	55	302	428	36.9	31.4	212.3	280.6
Bird	1	-	-	1	0.2	-	-	0.2
Bird eggshell	-	+	-	+				
Total	80	62	331	473	98.1	101.7	444.4	644.2

Table 19.5. Modified vertebrate remains from Layer XV.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	1	-	-	-	2	7	-	-	-	8	-	8
5-6, mammal	1	1	2	-	*	*	3	-	2	27	-	32
4-5, large canid	-	-	-	-	-	1	-	-	-	2	-	2
4-5, mammal	-	-	-	-	-	-	-	-	-	1	-	1
3, mammal	-	-	-	1	-	-	-	-	-	1	-	1
-, mammal	1	91	-	9	*	*	-	*	*	*	-	428
Bird	-	-	-	-	-	1	-	-	-	-	1	1

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

Size 5-6 mammal, unidentified, n=32: three tooth, one rib, 26 long bone shaft fragments. One of the long bone fragments has been flaked by use as a chopper bit, and one is charred. Carnivore tooth punctures are seen on a rib and a long bone fragment.

Wolf, Dog or Coyote, NISP=2: distal metapodial, 1st phalanx.

Size 4-5 mammal, unidentified, n=1: vertebra.

Size 3 mammal, unidentified, n=1: long bone shaft fragment. This bone has been digested and occurred in hearth F15-a.

Unidentified mammal, n=428: fragments less than 6 cm in length. One exhibits a single cut mark, 74 are charred and 17 are calcined. Of nine digested fragments, eight are from XU 6 and seven were in hearth F15-a. Small fragments are much more abundant in XU 6 than in the other two units, and 110 of them, including 53 burned specimens, were recovered from the hearth.

Bird, unidentified, n=1: cervical vertebra; eggshell fragments. The vertebra is from a gull- or raven-sized bird. Measurements of their thickness show that the eggshell fragments are from a much larger bird such as a swan or a pelican.

Snails: One small gastropod was recovered from XU 4.

Discussion. Portions of one bison were butchered for meat and marrow, and diet may have been supplemented by the flesh and/or eggs of birds. The canid elements may have no dietary significance since they could be derived from a skin that still contained some foot bones.

Interpretation of Layer XV

Activities in Layer XV took place around a single dung hearth about 3 m north of the present creek bank. Within a short reach to the east was a cluster of fired rock and bone fragments which we interpret as materials from a boiling vessel, a hide vessel suspended on sticks above the ground. Rocks heated on the dung fire could have been lifted from the fire with tongs, brushed free of ash, and dropped into the boiling vessel as needed to keep the contents hot. Rocks which had discharged their heat into the fluid could have been retrieved with a spoon or tongs, and dropped at the foot of the apparatus until needed for another heating cycle. We presume that the vessel contained a stew of bison flesh and bones, since bison bones comprise most of the faunal remains recovered from the occupation including the immediate vicinity of the hearth and rock cluster. Such a stew may have been supplemented by the flesh and eggs of a couple of kinds of birds. A trace of canid bones was also present.

The hearth contained a fair amount of fragmented bone, some of it well burned. This could be due to the roasting and breaking of bones for marrow at fireside. It could also be due to disposal of some bone fragments from the boiling vessel into the fire. The bit of a bone chopper was discovered near the hearth. It may have been used for stripping flesh from bones. There was a little chipping debris in and around the hearth reflecting tests of a cobble of poor raw material and minor repair of some stone tools. There was a second cluster of fired rocks about 3 m south of the hearth at the edge of the modern creek bank, possibly the site of a second boiling vessel.

About 4 m east of the hearth was a small boulder underlain by a few fire-broken rocks and two linear arrangements of charcoal. This may have been the center of a sweat lodge, hot rocks upon which water was dropped to make steam. The same hearth used to heat rocks for boiling vessel(s) could have been used to heat rocks for the sweat lodge. A couple of chipped stone cores were discarded near the sweat lodge, but there is little additional evidence for stone chipping in that area.

The identity of Layer XV occupants is unknown aside from the fact that they were bison hunters and included males (the hunters). Size of the group is also unclear. It may have been large enough to require more than one boiling vessel. The age of occupation was between about 950 and 650 BC (cal 2900-2600 BP; Table 3.6). Since the amount of debris and number of animals consumed were both small, the length of occupation was probably in the order of one to several days. The season, as indicated by egg shells, may have been summer.

Chapter 20

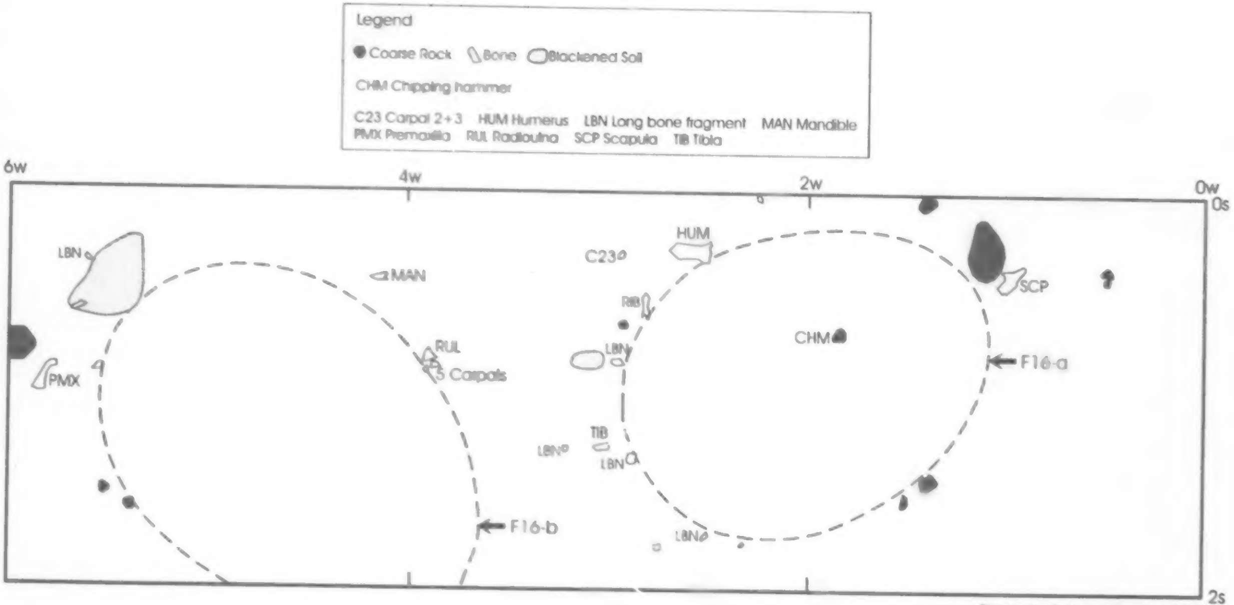
Layer XVI: A One-Night Stand

Introduction and Planview

Layer XVI, an occupation of unknown identity, begins about 296 cm BS and continues to about 303 cm BS at 0n2w. Most cultural items were at depths of 299-303 cm BS. The occupation occurs at a very subtle contact between buff-coloured deposits above and below. Were it not for a sparse scattering of stone, bone and pieces of charcoal, the layer would be difficult to distinguish from its enclosing matrix. Because of the sparseness of remains we have hesitated to identify features. However, we do see a repeated pattern which we find hard to ignore and which we interpret as being two sleeping areas (Fig. 20.1). There was only one tool in the layer, a chipping hammer. Analysis of coarse rock is based on collected materials and on estimations (from drawings and photographs) for two larger rocks which were not collected (one left in profile, the other discarded). The two estimated weights are included with figures under the unidentified category. Analysis of faunal remains is based on a complete collection from XUs 4-6, a sample for a radiocarbon date having been drawn from an adjoining test profile. The age of Layer XVI is estimated to be between 1050 and 750 BC (cal 3000-2700 BP; Table 3.6). Interlayer XVI/XVII varied in thickness from as little as 2 cm to as much as 10 cm, the variance being due mainly to slope and undulations in Layer XVII. Interlayer deposits from XU 5 were trowelled and screened; deposits from the other units were trowelled and discarded unscreened. Part of a large, almost completely infilled animal den cut through the south edge of XU 4 removing a 2100 cm^2 area of the occupation and interlayer deposits.

Features

Feature F16-a (Fig. 20.1, Table 20.1) consisted of a sparse scatter of broken bones, a small hearth and some coarse rock in a roughly oval configuration surrounding an elliptical void which spanned XUs 4 and 5. The long axis of the void measured about 187 cm (northeast to southwest) and the short axis about 137 cm. The west end of the void was defined by an arcuate scatter of bone fragments about 175 cm in length and 25 cm in width. At the center of this curved cluster was a patch of blackened earth, about 22 cm long, containing at least one chunk of charcoal. This blackened area is presumed to have been the remains of a small hearth. The northeastern edge of the void was a smaller cluster of objects consisting of a large flat cobble (center), a small rock some 25 cm to the northwest, and a large bone fragment about 5 cm to the southeast. There were two small rocks on the southeast margin of the void. Altogether, scattered remains around the F16-a void accounted for the majority of materials in XUs 4 and 5. The void itself did contain one object, a chipping hammer, about 15 cm northeast of center. This is the only tool discovered in the layer. Having described F16-a,


Legend
● Coarse Rock
Bone
Blackened Soil
CHM Chipping hammer
C23 Carpal 2+3
HUM Humerus
LBN Long bone fragment
MAN Mandible
PMX Premaxilla
RUL Radioulna
SCP Scapula
TIB Tibia
6w
4w
2w
0w
0s
2s
LBN
MAN
C23
HUM
SCP
RIB
CHM
RUL
5 Carpals
LBN
PMX
F16-a
TIB
LBN
LBN
F16-b
LBN

Planview by ID. Corel rendition by REM

Figure 20.1. Planview of Sjovold Layer XVI.

Table 20.1. Speculative features in Layer XVI.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F16-a	snacking/sleeping area	85s200w	180	150	1
F16-b	snacking/sleeping area	120s465w	>165	180	1

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

we turn to F16-b, a similar feature, before attempting a joint interpretation.

Feature F16-b, apparently also a patch of empty occupation surface, was bounded, at least partially, by bone and stone fragments and a cluster of charcoal. Because it was less well defined and not completely exposed by excavations, F16-b would not have been recognized except for the earlier recognition of F16-a. Nevertheless, it seems to have possessed similar elements, though in a slightly different configuration. The northwest edge of F16-b, situated near the west edge of XU 6, was marked by an arcuate cluster of debris consisting of a patch of charcoal, bone fragments and stones. The charcoal patch was about 45 cm long and was bordered by a couple of bone fragments. Some 25 cm to the southwest was a large stone only part of which was exposed by excavations. South and east were a couple more bone fragments and a couple of stones. The only other items in the unit, apparently on the east edge of the void, were about 1.5 m to the east of the west edge and included a small cluster of bone fragments. There was nothing within the central void in this case.

Our explanation for the F16-a and F16-b patterns is that they represent the remains of outdoor sleeping and eating areas. Accordingly, a person or persons could have slept, sat and/or lounged in the areas which were void of cultural remains. They would have maintained small fires at the edges or ends of the sleeping areas both for warmth and for use in a limited amount of cooking or snacking. It will be noticed that the suspect hearths for both F16-a and F16-b were in the midst of fragmented bones. In the case of F16-b there were also a few coarse rocks nearby, one large enough to have served as an anvil for bone breaking. Presumably the meat and marrow bones were heated on the hearth and then bones were broken on the larger rocks so the marrow could be extracted and consumed. In the case of F16-a there was a large rock present, but it was at the end of the void opposite the hearth. Bone breaking in that instance either was not closely associated with the heating area or else there was another heating area nearby that was not uncovered by our excavations. Yet another possibility is that the large rock in F16-a was brought there mainly for use as a stone chipping anvil. A chipping hammer found at the center of F16-a prompts this idea, however, the amount of chipping debris in the vicinity of the rock was very sparse.

Having proposed such an interpretation we wish to elaborate it slightly for comparison. One might ask, for an example, why debris had accumulated only beyond the edges of the voids and not within them. The answer might be that there was some sort of bedding on the sleeping areas or that the sleeping spots were used for more than one night and were kept free of debris for comfort. Another question concerns the orientation(s) in which the supposed sleepers lay. Our guess is that the sleeping position was along the long axes of the voids (minimum length of 1.87 m) since the short axes (maximum width 1.55 m) seem too small to accommodate a grown person or persons in a stretched-out position. Thus, sleepers probably lay with either heads or feet toward the fires. A further question concerns whether the features were inside or outside a dwelling. The close proximity of the features to one another and the separate hearths lead us to the inference that they were in the open.

When one compares the hypothetical F16-a and F16-b sleeping features to examples of unsheltered or semi-sheltered sleeping areas known to have been used by hunting and gathering peoples (e.g. Hayden 1979a: Fig.125B; Binford 1983:96-100) one finds some strong correspondences and a few differences. The similarities include elliptical to rounded-rectangular sleeping areas ranging from about 1.55-2.1 m in length and from 0.66-1.91 m in width; small hearths at the edges of the sleeping areas or nearby; bone debris touching or overlapping the sleeping areas; the odd piece of chipped stone debris and the odd tool near the sleeping areas; and a closely spaced arrangement of multiple sleeping units. Binford (1983:97) sketches a generalized model of hunter-gatherer outdoor sleeping areas in which he emphasises the notion that hearths tend to be located toward the middle of one side of each sleeping area and that multiple sleeping places tend to be laid out parallel to one another making a row comprising a hearth, a sleeping place, another hearth, another sleeping place and so on. In contrast to this model the Layer XVI features seem to have their hearths exclusively at the ends rather than at the sides, and they are not parallel to one another. However, when one examines some of the case material on which Binford's model was based, for example Hayden's (1979a:Fig.125B) site plan of Walukaritji in Australia, one notices that there are hearths situated toward the heads and beyond the feet of sleeping areas. Moreover, where bone fragments are associated with hearths at all, they tend to be with hearths situated toward the heads or feet of sleeping areas, not usually with hearths at the sides. From this one might infer that side hearths had more to do with warming sleepers while head or foot hearths were more often for cooking. The explanation for an absence of side hearths at the Sjovold site, therefore, might be that during that particular occupation the night air was sufficiently warm to make such hearths unnecessary except for food warming. In any case, Sjovold features F16-a and F16-b, which at first appeared to be anomalous, now appear to fall within the documented range of pattern(s) for outdoor hunter/gatherer sleeping sites.

Rock

The sample of coarse rock from Layer XVI is a small one (Table 20.2). The bulk of its weight was in the two rocks which were left in the field. According to our photographic records both appear to have been granite, but since we cannot examine them closely they are included in Table 20.2 under the unidentified category. The largest, a whole cobble, was situated at the east end of F16-a and has already been interpreted as a possible anvil. The other was situated at the west end of F16-b, may also have been a whole cobble, and may also have served as an anvil. The balance of the sample is

F-6

Table 20.2. Coarse rock from Layer XVI.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
granite	3	2	1	6	119	36	74	229
limestone	-	-	3	3	-	-	4	4
quartzite	1	-	1	2	499	-	108	607
unidentified	1	-	7	8	4930	-	2277	7,207
Total	5	2	12	19	5,548	36	2,463	8,047

comprised mainly of fire-broken granite and two pieces of quartzite. The larger of the quartzite rocks, from the south edge of F16-a, is a blocky fragment derived from a fairly large cobble. It has been partially colour-altered from grey-yellow to rusty red and has additional surface blackening, all of which suggest that it was fire-broken. The other quartzitic item, a small smooth pebble (catno 6958) from the south edge of F16-b, appeared at first glance to be culturally unaltered. However, under closer examination we noticed two curious kinds of alterations: a group of more than 40 small impact marks (each less than 1 mm in diameter) along one quarter of the "edge," in an area about 17x17 mm adjoining the ventral face. There is no measurable depth to the impact points - they are small areas of slight cortical crushing marked by lighter colour than the surrounding cortex. There is also a thin adhesion of reddish material resembling blood residue in the crevices of a rough portion of cortex. The impact scars and red residue may be attributes of a hammerstone used to break bone.

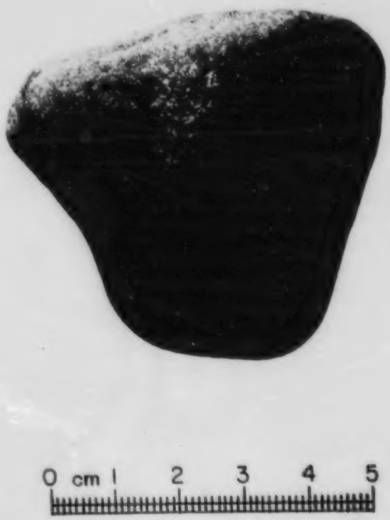


Figure 20.2. Chipping hammer from Layer XVI.

Stone Tools

Catno 6935, the single stone tool from Layer XVI, is a quadrilateral andesite pebble weighing 200.9 g with pitted areas on both dorsal and ventral faces. The flatter of the two faces, which we refer to as dorsal, has the most concentrated pitting - within a small area situated a little off center and about 1 cm from the longest edge (see Fig. 20.2). The dimensions of the pitted area are 10x15 mm and the depth varies from 0-1 mm. The pits are difficult to count because of overlapping. One might guess there are about a dozen. Most are actually short shallow grooves measuring from 3-8 mm in length, 1-2 mm in width and less than 1 mm in depth. The pit walls are irregular and fresh as if due to crushing impact with a short sharp-edged object. Because this group of pits is situated off the center of the face, toward one edge, one suspects that the tool served as a hammer rather than as an anvil. The impacted material was evidently sharp and very hard, probably chippable stone. On the opposite face there is a second group of pits, of the same kind, occupying an equivalent area, in an equivalent position, but including only about half the number of pits. Thus, it would appear that catno 6935 was a chipping hammer that received very little use before it was discarded. The tool was found near the center of F16-a.

Chipped Stone Debris

The only piece of chipping debris recovered from Layer XVI (XU 6) is a colourless quartz flake weighing 0.3 g.

Faunal Remains

Bison, NISP=15: premaxilla, two mandibular symphyses, distal scapula ♀/©, distal humerus ♂, distal radioulna ♀, radial carpal ♀/©, intermediate carpal ♀/©, ulnar carpal ♀/©, two carpal 2+3 ♀/© ♀/©, carpal 4 ♀/©, femur shaft, tibia shaft, proximal lateral sesamoid. Although the humerus is from a bull, the scapula represents the cow/calf group. Except for a right carpal 2+3, the carpals can be perfectly re-articulated with the left radioulna, and the entire assembly undoubtedly entered the site as a unit. Both the radioulna and the tibia shaft exhibit well preserved impact points. The mandibular symphyses can be re-articulated and were fractured as a unit. The premaxilla has a cluster of scrape marks on its medial surface. Of three weathered bones, only one has reached Stage 2.

Size 5-6 mammal, unidentified, n=10: one cranial, one tooth, two rib, six long bone shaft fragments. Multiple cut marks appear on a rib and a long bone fragment.

Unidentified mammal, n=125: fragments less than 6 cm long. One has a cut mark, one is charred, and one is calcined. There are 16 digested fragments that may have been in a single cluster on the boundary between XU 5 and XU 6.

Eagle, NISP=1: hind distal phalanx (talon). This bone was found in the creek bank between south-facing profiles 3 and 4 at a level correlated with Layer XVI. It has been bleached white by exposure to the sun. The talon is too large to represent a hawk, but it could be derived from either golden or bald eagle, both of which probably occurred in the study area in pre-contact time (Godfrey 1966:95-98).

Table 20.3. Vertebrate remains from Layer XVI.[a]

Size, Taxon	Number XU 4	XU 5	XU 6	Total	Weight XU 4	XU 5	XU 6	Total
6, Bison	2	10	3	15	215.3	941.7	139.9	1,296.9
5-6, mammal	1	7	2	10	2.1	54.2	17.2	73.5
-, mammal	15	30	80	125	8.1	13.5	33.1	54.7
Total	18	47	85	150	225.5	1,009.4	190.2	1,425.1

a. An eagle talon found in the eroded creek bank is correlated with this layer.

Table 20.4. Modified vertebrate remains from Layer XVI.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	1	-	-	-	3	7	-	-	-	7	8	15
5-6, mammal	2	-	-	-	*	*	1	-	1	8	-	10
-, mammal	1	2	-	16	*	*	-	*	*	*	-	125
Eagle	-	-	-	-	-	-	-	-	-	-	1	1

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

Discussion. The excavation must have intercepted a fairly sparse area in a much larger bone scatter, because both bison genders are represented among only 14 bones, many of which can be rearticulated to form complex butchering units (a wrist and perhaps a snout). Many of the bison elements in Interlayer XVI/XVII undoubtedly belong with these remains.

Interpretation of Layer XVI

Layer XVI contained what we believe to have been two snacking/sleeping areas, each defined by a narrow intermittent border of debris (broken bones, rocks and a hearth) around a roughly 2 m long elliptical void. Each void could have accommodated one or two people in sleeping positions. Subsistence in this part of the site was based on parts of two bison, a bull and a cow. It appears that butchering units such as a lower front limb and a snout plus a few other bones were brought to the sleeping areas, roasted on small adjoining hearths, and broken for marrow. The resulting bone fragments were sparsely scattered around the hearths, around the bone breaking anvils, and around the edges of the sleeping areas. The only definite tool we found was a stone chipping hammer. There was only one piece of chipping debris in this exposure. Therefore, stone chipping activities may have been concentrated in other parts of the site. Unfortunately, the absence of diagnostic tools leaves us without an archaeological identity for the occupants. A radiocarbon date on bone indicates that

Table 20.5. Coarse rock from Interlayer XVI/XVII.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
andesite	-	1	-	1	-	249	-	249
diabase	1	-	-	1	144	-	-	144
granite	2	6	3	11	235	114	1143	1,492
grano-gneiss	-	2	1	3	-	7	36	43
limestone	1	-	-	1	2	-	-	2
quartzite	1	1	-	2	545	11	-	556
unidentified	3	13	-	16	20	23	-	43
Total	8	23	4	35	946	404	1,179	2,529

occupation took place 1050-750 BC (cal 3000-2700 BP; Table 3.6). Our suspicion, based on an absence of warming fires at the sides of the sleeping areas, is that occupation occurred during warm weather.

Interlayer XVI/XVII

Coarse Rock (Table 20.5): Granite and quartzite dominate the sample of coarse rocks from the interlayer. The granite was almost all fire-cracked, as was the andesite, diabase and the smaller part of the quartzite. One buff-coloured quartzite cobble (545 g) does not appear to have been fired, but has a pitted area, possibly of cultural origin, that is 12x20x1 mm deep and situated on the apex of one end. There is a fairly close correspondence between the kinds and proportions of coarse rock in the interlayer and in Layer XVI. Thus, most of the interlayer material may have been derived from Layer XVI by a combination of trampling and animal disturbance. However, given the very short distance in some places between Layers XVI and XVII, it is also possible that a few pieces are from the top of Layer XVII.

Chipped Stone Debris: There were two matching pieces of grey-white quartzite in XU 5 of the Interlayer. Together, they comprise most of a large (40.8 g) shattered flake which had been struck from a simple core, that is, a core in which the striking platform is simply cobble cortex.

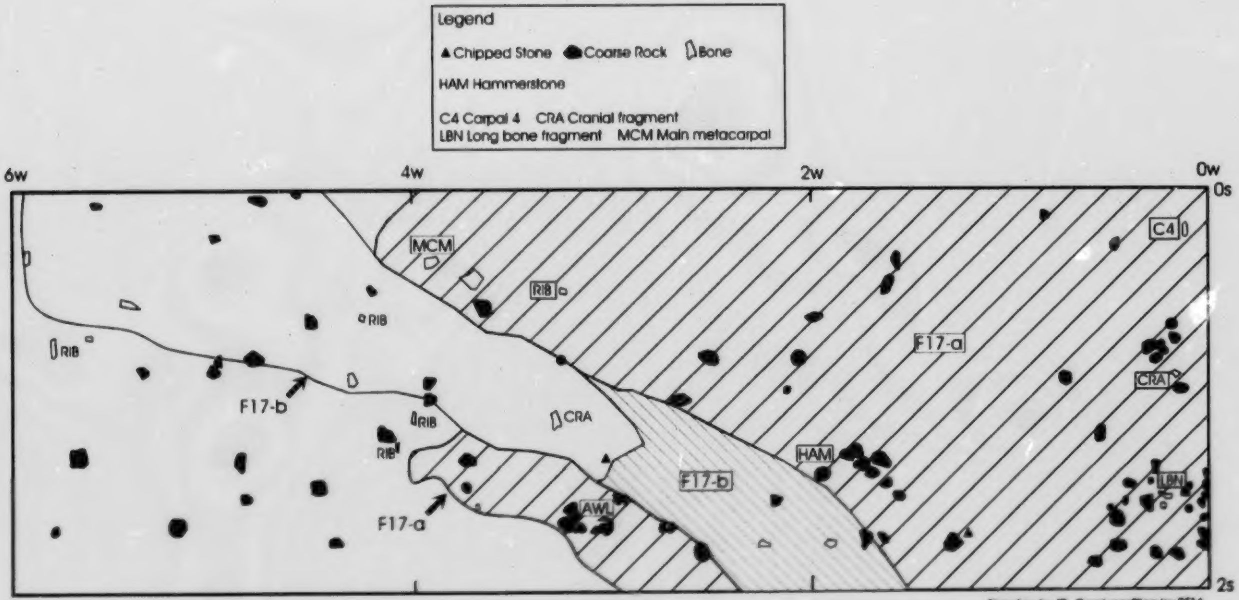
Faunal Remains:

Bison, NISP=14 (534.0 g): maxilla, temporal, mandible with P_3-M_3 ♀ (AG 10-11), lumbar transverse spine, rib, humerus shaft ©, ulna shaft, three tibia shafts, metatarsal shaft, three proximal medial sesamoids ©. Whereas the mandible represents a very old cow, the humerus shaft and sesamoids come from a bison calf. The ulna has a cluster of scrape marks, and the metatarsal bears multiple incisions that might have been inflicted while removing the hide. Ten specimens were fractured when fresh, and the tibia and metatarsal shafts have well preserved impact scars; one tibia shaft fragment bears three such scars adjacent to the anterior crest. Another tibia shaft was gnawed by a carnivore, but the gnawing is superficial and does not appear to be associated with the fracturing of the bone. Likewise, gnawing on the mandible appears to post-date fracturing that removed the lower border. The three sesamoids have been digested, but they did not occur together, each being found in a different excavation unit. Ten bones have been superficially etched by rootlets, but none shows signs of weathering.

Size 5-6 mammal, unidentified, n=8 (47.3 g): five rib, three long bone fragments. All were fractured when fresh, and one rib bears multiple cut marks.

Unidentified mammal, n=234 (82.9 g): fragments less than 4 cm in length. Twenty-three digested fragments may have been in a single cluster on the border between XU 5 and XU 6.

Interpretation of Interlayer XVI/XVII: Most of the interlayer materials were probably derived from Layer XVI, perhaps dispersed downward by trampling. If so, the bison mandible in this interlayer may represent the cow whose scapula and wrist were encountered in Layer XVI, but the immature bison that contained the humerus and sesamoids in the interlayer was not perceived in Layer XVI. We cannot rule out the possibility that some of the interlayer remains belong in Layer XVII.


Legend
▲ Chipped Stone
Coarse Rock
Bone
HAM Hammerstone
C4 Carpal 4
CRA Cranial fragment
LBN Long bone fragment
MCM Main metacarpal
6w
4w
2w
0w
0s
2s
MCM
RIB
RIB
RIB
RIB
RIB
F17-a
F17-b
F17-b
F17-a
CRA
CRA
HAM
AWL
C4
LBN

Planview by ID, Corel rendition by REM

Figure 21.1. Planview of Sjovold Layer XVII.

Chapter 21

Layer XVII: A Roasting Trough

Introduction and Planview

Layer XVII, another occupation of unknown identity, begins at 307 cm BS and continues to 312 cm BS at 0n2w. Soil blackening, due to extensive firing of the occupation surface, made this the most easily distinguished of all occupation layers. Charcoal, ash, and reddened earth were found throughout our exposure. Cultural contents included two large features, one hammerstone, and two bone tools, a few pieces of chipping debitage and a fair amount of fragmented coarse rock and bone (Fig. 21.1). Unfortunately, there is nothing which could be considered diagnostic of a particular complex.

The age of the occupation is interpolated to between about 1250 and 950 BC (cal 3200-2900 BP; Table 3.6). Layer XVII is nearly level with very broad shallow undulations. In addition to cultural disturbance, there were signs of animal burrowing through and below the occupation surface. A long branching burrow, within the occupation zone and paralleling the occupation surface, ran through the north part of XU 6 toward the middle of XU 5. Its main channel was about 7 cm wide, and it had a couple of bulges and side branches up to 15 cm in width. The burrow was completely infilled with a homogeneous yellow silty clay which, standing in contrast to bordering blackened or mottled grey soils, made it very easy to see. A couple of areas of yellow-grey silty clay, possibly parts of a single burrow, were situated along the northeast edge of XU 5 extending into the northwest corner of XU 4. These seemed to comprise two low bulbous "chambers" connected by a narrow passage. With a combined length of 2.25 m and a maximum width of more than 0.75 m, the broadest part of this system was probably only 7-10 cm in height. We found it hard to distinguish ceiling and floor as the fill was similar in colour and texture to sediments enclosing the whole layer. At one point, burrow and broader chamber lay within 15 cm of one another and, although we did not see a connection between them, it is possible that they were connected in a plane or at a place we failed to notice. Part of another large subterranean chamber, a continuation of the one first encountered in Layer XV, was found on the south edge of XU 4. Interlayer XVII/XVIII lies immediately below Layer XVII and is about 8-10 cm in thickness. We trowelled and screened its top 2 cm and the few cultural pieces recovered are included with those of Layer XVII. The remainder of the interlayer was stripped out with coal shovels and discarded without screening.

Features

Feature 17-a (Figs. 21.1-21.2, Table 21.1), an extensive area of burned occupation surface, was only partly exposed by our excavations. The part we saw occupied all of XU 4 and a good portion

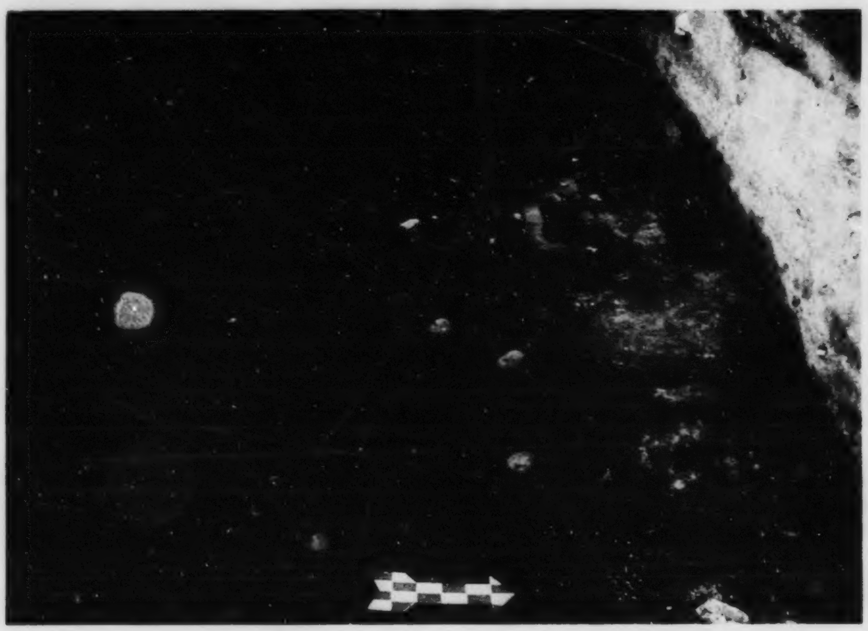


Figure 21.2. Extended hearth F17-a (foreground) and roasting trough F17-b (middle and upper) viewed from the east. RSM #EiNs-4:80-243 CT.

Table 21.1. Features in Layer XVII.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F17-a	extended hearth	100s100w	>200	>600	1-7
F17-b	roasting trough	85s380w	>95	>425	0-10

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

of XU 5 where it engulfed a second feature, F17-b. The surface of F17-a was generally flat except where it dipped down through the trough of F17-b. F17-a was comprised of two layers. A thin upper layer (1-3 cm thick, exclusive of stones) was coincident with the occupation surface and consisted of fire-modified earth and combustion byproducts — a patchwork of jet-black and ashy-white soils, grey soils, reddish-orange soils and mixed patches of grey, black, yellow and ashy-white. Resting on and in the surface layer were pebbles and pieces of coarse rock showing a certain degree of clustering along both sides of the trough and toward the southeast corner of XU 4, plus some 470 grams of well-scattered broken fragments some of which were burned, a pointed bone tool, a stone chipping hammer, and a small handful of chipped stone debris. Immediately underlying that was a 0.5-1.0 cm thick subsurface layer of brown soil with a faint reddish-orange hue, the colour presumably due to (shallow) heat penetration from the base of the fire immediately above.

The thickest and most ash-laden part of the feature was just north of center in XU 4. Surrounding that were clusters of rock and bone resting on and beside patches of reddish-orange earth; one in the northeast corner of XU 4, one in the southeast corner, and another, somewhat more dispersed and more blackish-orange, on the southwest and west edges of XU 4. Thus, it would appear that the center of the hearth was near the center of XU 4. An extension to the west was indicated by surface patches of black, red-black, and ever more grey-brown and yellow-grey soil, but little indication of (undisturbed) ash. The western limits were defined by the limit of larger patches of black soil which was near the west edge of XU 5. This may underestimate the real western limit of the hearth extension by a couple of meters since at least one more patch of mainly black soil was found in the southwest quarter of XU 6. That variance will be taken into account in the overall interpretation of the features.

We found a few small articulated pieces of charred wood, apparently representing charred twigs, on the west edge of the hearth core in XU 5. However, charcoal was rare. That rareness, together with the mottling of the burned surface and the shallow subsurface burning, may be indications that bison chips were the principal fuel (Wright 1986).

Feature 17-b was comprised of two main parts: (1) a long shallow trough occupying the southwest quarter of hearth F17-a and projecting out its west end, and (2) a mixture of buff-yellow, grey-brown, and black soil and burnt rocks lying on the occupation surface along the south edge of the trough (see Fig. 21.2) Recognizing the trough as belonging to the occupation was the key to identifying it as a feature. For a long time we thought that it was an animal burrow, perhaps made by the same mid-size animal which dug the large den on the south side of XU 4. Eventually, however, we found that such an interpretation did not stand up to close inspection. For one thing the depth-to-width ratio was about 1:4 which seemed grossly out of proportion for a burrow. Moreover, the profile of the depression's wall, curving onto the occupation surface, and the sinuous nature of its border in plan both indicated that this was a trough and not a burrow. The next proposition we considered was that the trough was a natural gully (or, alternatively, an animal trail) which simply crossed over the occupation surface. We observed that the trough floor varied from greyish-brown silty clay at the west end to mottled black, grey-brown, and red-orange silty clay for the eastern portion which lay within hearth F17-a. This evidence for firing of the floor made it clear that the trough had been present during the occupation, but it did not help us to decide whether it was cut by animal hooves or excavated by humans. The deciding fact was the termination of the trough just before it reached the west wall of XU 6. A trail, especially one heading away from the creek, would not simply end at that point. Thus, we are inclined to believe that the trough was of human manufacture. This brings us to the deposits along its south side, an area at the same level as the general occupation surface. That area was covered with an unusual mixture of patchy buff-yellow and greyish-brown soil containing numerous medium to small pieces of fired rock and the odd bone fragment. The unusual aspect was that the yellow and grey-brown patches, which varied from 5-20 cm in size, were often fringed with narrow bands of jet black soil. Overall, this deposit, lying on the south side of the trough, seemed to have an irregular overlapping pattern. This is what one would expect if a topping of earth and hearth remains had been shovelled from one place to another. The closest source, obviously, would have been the trough. Thus, we believe that the trough and the mixed deposits immediately to the south were parts of a man-made feature.

Our interpretation of F17-b is that it functioned as a roasting trough in which a substance such as cuts of bison was cooked. The inferred method of construction and use would have involved digging a shallow trench beside a hearth, partly to make a hole in which to do the roasting and partly to create loose soil. The floor of the trough may have been preheated by dragging coals onto it from the adjoining hearth. We are uncertain about the preheating since the degree of firing on the trough floor was not uniform throughout. When the floor was ready the meat would have been wrapped in rawhide or damp clay or green foliage to keep it clean, and then laid in the trough. Loose soil would have been piled on top until the wrapped package(s) was completely covered, and then a fire would have been built or dragged onto the covering soil to supply heat for roasting. When the meat was cooked, the coals and loose earth would have been shovelled off and the roasted meat would have been removed and eaten. If the main hearth at the end of the trough was needed for other purposes after the roasting, the nearest part of the bared trough floor might simply have been incorporated into the hearth, thus accounting for a more severe firing of the trough in that area.

There are a number of historical descriptions which show that similar cooking methods were actually used by northern Plains Indians.

Referring to the Atsina, Edward Curtis (1980, Vol. 4:152) writes that, "Meat was roasted by placing it in a shallow excavation, stretching over it a piece of rawhide, covering the latter with fresh earth, and building the fire on that."

In reference to Sioux hunting parties, Charles Eastman (1975:95) noted that, "Generally we broiled our meat over the coals on a stick. We roasted some of it over the open fire. But the best way to cook fish and birds is in the ashes under a big fire. We take the fish fresh from the creek or lake, have a good fire on the sand, dig in the sandy ashes and bury it deep. The same thing is done in case of a bird, only we wet the feathers first. When it is done, the scales or feathers and skin are stripped off whole, and the delicious meat retains all its juices and flavour. We pulled it off as we ate, leaving the bones undisturbed."

Elsewhere, Eastman (1974:74-75) elaborated on the advantages and methods of buried cooking observing that, "When you wish to hunt or to leave camp for any length of time while your meal is cooking...you had better resort to casing the food in wet clay and burying it fairly deep in ashes or sand under a good fire. If you have birds it is only necessary to wet the feathers thoroughly before burying them, and they will come out juicy and delicious under a black coat that peels off like the skin of an onion. Fish cooks perfectly in this manner, as do potatoes, green corn, shellfish - in fact, almost anything. It should be done in two or three hours, but you may leave it all day if necessary without harm."

Also referring to the Sioux, Royal Hassrick (1964:173) wrote that, "Men cooked fish in a small pit lined with leaves. Over these leaves the cleaned fish were laid. They were covered with a row of sticks, and above them were placed more leaves. Finally a thin layer of earth was spread level with the surface of the surrounding ground. Then a large fire was built over the pit. When it burned down to a few remaining coals, the earth and leaves and sticks were removed, leaving the fish thoroughly baked in their leafy oven...."

Referring to cooking practices of Assiniboine men away from their base camps, Michael Kennedy (1961:80) notes that, "A hole about two feet square and a foot or more in depth was dug. Into that was laid a piece of ribs wrapped in a green buffalo hide. This was then covered with dirt and a fire built over it.... When the first fire had died down to embers, a fresh pile of fuel was laid on, and when the last fuel was all burned, the meat was considered done. They called this method "ribs covered and cooked with two fires."

From these historical observations it will be seen that the function inferred for feature F17-b generally falls within the range known for northern Plains Indian shallow-pit cooking. There are sufficient characteristics in common - the shallow pit, the covering earth, the direct application of fire on top of the covering earth - to believe that the methods and features described in the historical references may be taken as an appropriate analogy for feature F17-b. In truth, there does seem to be a little discrepancy between the pits described in the analogies and the trough we found in Layer XVII. The analogies refer to "burying fairly deep in ashes" or digging "a foot [30.5 cm] or more in depth". F17-a was only about 10 cm deep. Where the analogies are specific they describe a square or circular pit. In one case the dimensions are recorded as being about two feet [61 cm] square which can be calculated to have provided a floor area of about 3700 cm^2. F17-a was nearly that wide (about 50 cm), but much longer (about 425 cm). It would have provided a floor area of more than 21,000 cm^2 which is much larger than the one specific historical example. Possible explanations for the variance are: (1) we do not know the true range of variation for historical examples, (2) the silty/clay occupation surface of Layer XVII was so dry and hard at the time of occupation that digging deep was a difficult task, making it simpler to dig a very shallow but more extensive pit, thereby creating sufficient loose earth to compensate with covering soil for what the pit lacked in depth, or (3) the substance to be roasted was thinner and more spread out than usual. Thus, we can imagine plausible explanations for the apparent variance. Overall, however, we think that the similarities between the analogies and F17-b far outweigh the differences and that the analogies strengthen our interpretation.

Turning back to feature F17-a, our interpretation, in brief, is that it was an extended hearth. By this we mean a hearth with a core area about 1.5 m in diameter centered in XU 4 and with a substantial surface extension up to 4 m long and about 1 m wide in a position that would have straddled the F17-b trough. Most of the hearth extension was not actually seen in place. The part covering the trough had been removed during use. The parts that overlapped onto the occupation surface at the sides of the trough could be seen in the eastern portion, but their continuation along the western margins had to be extrapolated. The northwestern margin of the trough was not exposed by our excavations. The southwestern side was covered with mixture of earth and fired earth and combustion byproducts which are suspected to have been removed from the top of the trough both during construction and after the roasting episode. Amongst these remains there were a couple of in situ black patches on the south side of the west end of the trough which appear to be evidence for extension of the hearth to that position. The reason for making the extension, of course, was to supply the heat necessary for a fairly even roasting of the trough's buried contents.

Pieces of debris marginal to the hearth core may indicate the occurrence of other hearth-related activities before, during and, in some cases, after the extension had served its purpose. There was, for example, a handful of chipping debris representing at least 6 different types of stone on the western side of the F17-a hearth core in XU 5. Some pieces showed surface blackening or colour changes indicative of exposure to fire. Evidently these were deposited before or during the hearth extension phase. A small hammerstone was found on the southwest margin of the core. An uncharred bone awl was on the southeast edge of the trough a little more than a meter west of the hearth core. The awl would seem to be evidence for activity after the extension had burned out. The presence of numerous small cobbles and fragments of coarse rock in the hearth and among the trough covering debris are also evidence for fire-related activities. The rock associated with the hearth core was mainly in three clusters, one on the east margin, one on the southeast margin and one on the southwest margin. Each was associated with a patch of red-orange soil and a few bone fragments. These clusters may have been the spots at which stones were heated, possibly for use in a stone-boiling operation. The clusters may also have served as props on which bones were roasted and broken for marrow. The presence of stones in the debris beside the trough, however, is puzzling. Why would stones be included in the fire over the roasting trough? Perhaps they were merely dragged along as an incidental part of the burning coals removed from the hearth core. On the other hand, they might have been deliberately included as heat retainers to prolong or even out the roasting process. Some experimental research might be helpful in answering this question. In any case, although a major function of hearth F17-a was to support of the trough-roasting operation, it was also the focus for modest amounts of other fireside activities.

Rock

Materials in the granite, gneiss and grano-gneiss group dominate the coarse rock sample with a combined 83.4% of the total weight (Table 21.2). This is a figure which is similar to that from

Table 21.2. Coarse rock from Layer XVII.

Material	Number XU 4	XU 5	XU 6	Total	Weight XU 4	XU 5	XU 6	Total
andesite	2	-	-	2	380	-	-	380
basalt	-	1	-	1	-	114	-	114
gneiss	13	5	4	22	1,809	178	210	2,197
granite	63	46	13	122	5,391	1,138	1,417	7,946
grano-gneiss	10	1	6	17	1,942	704	1,908	4,554
limestone	2	5	7	14	331	5	15	351
quartzite	-	6	-	6	-	1,813	-	1,813
sandstone	-	1	-	1	-	5	-	5
unidentified	30	47	17	94	20	92	158	270
Total	120	112	47	279	9,873	4,049	3,708	17,630

layers X, XIV and some others in the site. The overwhelming majority of rock in Layer XVII exhibits some combination black smears, colour changes and blocky or irregular fractures — indicative of intense exposure to fire. This fired rock may have served more than one purpose. Stone-boiling is a possibility and use as heat retainers in the roasting trough is another. Use as props and anvils around the margins of the hearth core is almost a certainty. Whatever the uses, the overall degree of disaggregation could be described as moderate, from which one could infer a moderate degree of use. Average weight is 63.2 g.

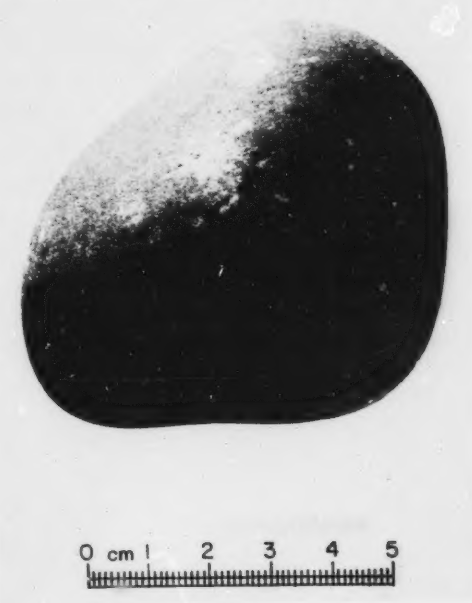


Figure 21.3. Chipping hammer from Layer XVII.

Stone Tools

The only stone tool found in Layer XVII is a quartzite pebble with three lightly battered areas on an otherwise smooth cortical surface. Catno 7005 weighs 308.7 g; measures 82 x 69 x 41 mm; and was found near a cluster of fired rock at the southwest margin of the hearth core. Two of the battered areas are on the dorsal (most convex) face of the pebble; they rest on either side of the apex (see Fig. 21.3). The third is just off center on the ventral face. The battered areas vary

Table 21.3. Chipped stone debris from Layer XVII.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
agate	1	-	2	3	0.3	-	0.3	0.6
chert	-	5	-	5	-	12.9	-	12.9
Knife River Flint	2	5	2	9	1.3	1.3	0.5	3.1
petrified peat	-	2	-	2	-	23.7	-	23.7
quartz	-	1	-	1	-	5.9	-	5.9
Swan River Chert	-	9	-	9	-	67.7	-	67.7
silicified sediment	-	4	-	4	-	3.2	-	3.2
unidentified	-	1	-	1	-	0.0	-	0.0
Total	3	27	4	34	1.6	114.7	0.8	117.1

from 10-15 mm in length and are about 10 mm wide. Each contains about 20 small "pits" about a millimeter across and generally less than a millimeter in depth. Occasionally several "pits" are aligned to make a short groove. Each of the battered areas also contains traces of a reddish or reddish-brown material adhering to the inner walls of some pits and, in a couple of cases, to the cortical surface adjoining the battered area. We believe that the battered areas are evidence for deliberate use as a tool rather than being merely the result of natural impacts. This view is based partly on the locations of the battered areas away from the more prominent "edges" of the pebble and partly on the close association with reddish adhesions which may be blood residue. The pebble may have been used as a hammerstone for breaking bones.

Chipped Stone Debris

The sample of chipping debris from Layer XVII is small and lacks cores (Table 21.3). However, at least 7 types of material are represented, one of them, Knife River Flint, being exotic to the district. Swan River Chert dominates the sample by weight (59.9%), but in terms of numbers Swan River Chert shares first position with Knife River Flint at 9 pieces each. The debris is a mixture of flakes from prepared cores, shatter, and medium and small retouch flakes. The largest piece of Knife River Flint is a bifacial retouching flake for which the striking platform includes a well-worn segment of a thin bifacial edge. This and some other pieces of the Knife River Flint are very dark brown or dark and cloudy brown-cream in colour which suggests rather extreme exposure to heat. They were probably discarded directly into the fire. A nodule of fine grey chert found in 4 pieces appears to have shattered in the fire. The distribution of chipped stone debris was very clearly biased toward XU 5 which was just beyond the west edge of the hearth core and which contained the beginning of the hearth extension and the east end of the roasting trough. Given the evidence for firing, at least some of the chipped stone must have been deposited before or during the operation of the roasting trough, probably before.

Bone Tools

A bison right distal metacarpal from XU 5 (catno 7013) has been heavily used as a hide grainer, producing a lateral bevel on the anterior surface (see Fig. 4.1).

A slender sliver of long bone is so extensively worked to make an awl or an uneyed needle that it can no longer be identified even to class (see Fig. 21.4). It is either mammal or bird bone and has been tabulated among the unidentified large mammal bones. It was found in XU 5 (catno 7019).

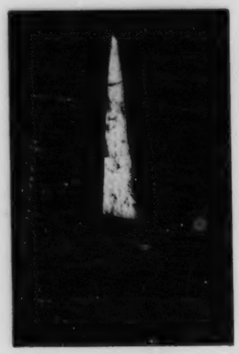


Figure 21.4. Bone awl from Layer XVII.

Faunal Remains

Bison, NISP=7: I_2 root, thoracic arch, two humerus shafts, ulna shaft, carpal 4 ♀/©, distal metacarpal ♂. All of these pieces are quite small.

Size 5-6 mammal, unidentified, n=22: five cranial, eight rib, nine long bone shaft fragments. One long bone fragment has been shaped as an awl, and one rib has been punctured by carnivore teeth.

Swift Fox, NISP=1: skull containing LI^1, LP^4-M^2, RI^1, and RM^2. This skull was crushed after desiccation and possibly after burial.

Rabbit or Hare, NISP=1: temporal bone.

Size 3 mammal, unidentified, n=1: long bone fragment, probably from the fox or the rabbit or hare.

Size 2 mammal, unidentified, n=3: one rib, two long bone shaft fragments. These bones might represent a ground squirrel but cannot be identified.

Unidentified mammal, n=630: fragments of which only 17 (4-10 cm) are more than 4 cm long. The 36 charred and 12 calcined fragments are scattered across all three excavation units. Most of the tooth-marked and digested specimens were found in XU 5.

Snails: One small gastropod and a larger fragment of a fossilized mollusk were found in XU 5. The fossil may have reached the site as a sedimentary particle, although it could have been collected

Table 21.4. Vertebrate remains from Layer XVII.

	Number				Weight			
Size, Taxon	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
6, Bison	2	2	3	7	16.5	80.3	46.9	143.7
5-6, mammal	4	12	6	22	88.9	99.3	61.1	249.3
3, Swift Fox	1	-	-	1	4.0	-	-	4.0
3, Rabbit or Hare	-	1	-	1	-	0.1	-	0.1
3, mammal	-	1	-	1	-	0.1	-	0.1
2, mammal	-	1	2	3	-	0.1	0.2	0.3
-, mammal	147	248	235	630	65.4	127.6	163.5	356.5
Total	154	265	246	665	174.8	307.5	271.7	754.0

Table 21.4. Modified vertebrate remains from Layer XVII.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	-	-	-	-	2	5	1	-	1	4	1	7
5-6, mammal	1	-	1	-	*	*	-	1	6	15	-	22
3, Swift Fox	-	-	-	-	-	-	-	-	1	-	-	1
3, Rabbit or Hare	-	-	-	-	-	1	-	-	-	1	-	1
3, mammal	-	-	-	-	-	1	-	-	-	1	-	1
2, mammal	-	-	-	-	-	2	-	-	-	3	-	3
-, mammal	-	48	3	10	*	*	-	*	*	*	-	630

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

as a curiosity.

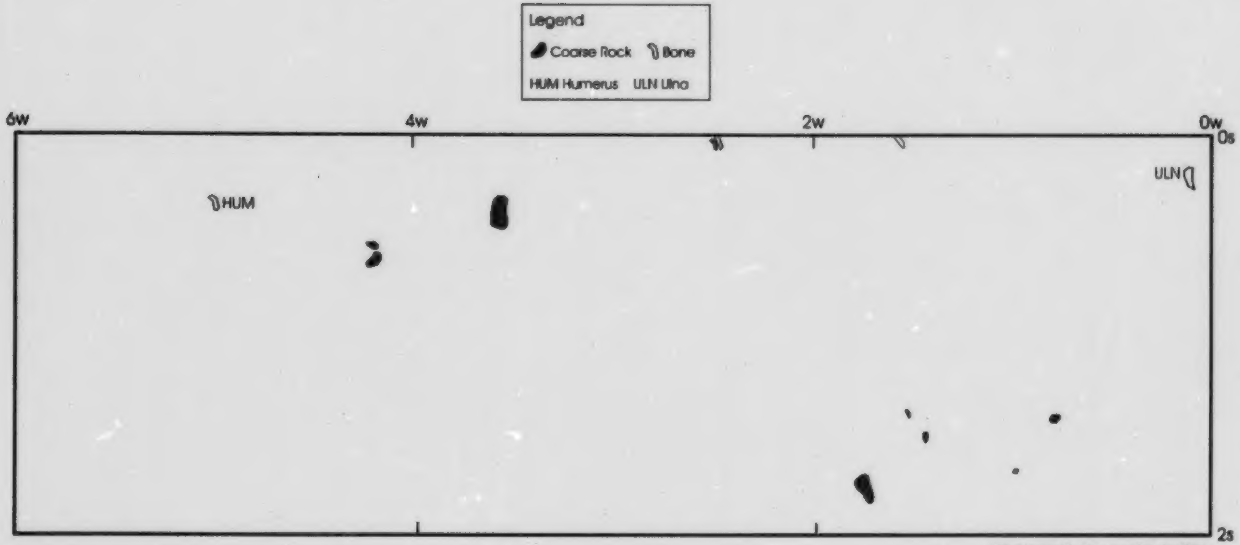
Discussion. With two bison genders represented by only seven bones, it is obvious that the sample is too small for detailed interpretation. It is interesting that the evidence for intense firing of Layer XVII is not reflected in the condition of the bones. Burned fragments are proportionately no more abundant here than in other layers of the site. The evidence for extensive dens and burrows may be relevant to the presence of the fox skull and the leporid bone. Swift foxes dwell in burrows and prey on leporids and other small mammals (Banfield 1974:302).

Interpretation of Layer XVII

Our exposure of Layer XVII revealed two features, an extended surface hearth and an associated subsurface roasting trough. The core of the hearth was about 1.5 m in diameter and centered in XU 4 about 2 m north of the current lip of the creek bank. Around the fringes were several clusters of broken stone and bone, the western ones including a couple of tools and most of the chipped stone sample from the layer. We infer that core-edge clusters of coarse rock and associated bone fragments were the remains of bone roasting platforms which were also used as bone breaking anvils. A small amount of stone tool repair and manufacture took place on the west edge of the hearth. During the life of the hearth a long shallow trough was dug from the southwest corner to a position about 4 m beyond its west edge. Items such as a whole small animal (e.g., a rabbit) and/or a cut or cuts of bison were either laid directly in the trough or else encased in some sort of wrapping (e.g., a green hide) and laid in the trough. These were covered with loose earth and then with combustible materials, possibly bison chips, in preparation for cooking. Hot coals were dragged from the hearth core to the combustible materials on the trough igniting a fire which cooked the buried meat. After the meat was cooked, the loose earth, ash and coals were shovelled or scraped off. Most of the covering earth and hearth materials were deposited along the south edge of the trough although some were left in the trough toward the west end. Hearth-side activities such meat consumption and bone roasting and breaking probably resumed around the hearth for a short time after the roasting was finished.

Subsistence in this layer was based on parts of two bison and possibly a rabbit and a swift fox. We presume that the game was obtained nearby. The coarse rock used in the fire was probably collected in the creek or river bed or on the valley slopes within a hundred meters of the hearth. Chipping debris is a mixture of locally available and exotic materials. From the high proportions of Swan River Chert and Knife River Flint we infer that the occupants were drawing most of their chippable stone from areas up to several hundred kilometers south of the site. Since the roasting trough is an excavated feature, its presence implies an occupation during a warm season when the ground is not frozen. The suspected use of bison chips is consistent with this interpretation since their collection would be difficult if snow covered the ground.

Given the combined size and extensiveness of the fired area, we infer that the hearth and roasting trough were sited out-of-doors, rather than within a shelter. The number of people served by these features was at least three or four since there was that number of rock and bone clusters around the hearth core. Neither the gender composition of the group nor its archaeological identity is known. However, the presence of large game makes it almost certain that adult males were members. The age of the occupation is estimated at 1250-950 BC (cal 3200-2900 BP; Table 3.6).


Legend
Coarse Rock
Bone
HUM Humerus
ULN Ulna
6w
4w
2w
0w
0s
2s
HUM
ULN

Planview by ID, Corel rendition by REM

Figure 22.1. Planview of Sjovold Layer XVIII.

Chapter 22

Layer XVIII: Cultural Remains in a Dubious Context

Introduction and Planview

Layer XVIII is an enigma. It consisted of a few bone fragments, a few fired rock fragments and a few small pieces of wood charcoal scattered across the surface of a 4-10 cm thick substratum of grey/buff clay situated about 10 cm below Layer XVII. The reason for the enigma is that we have not found a satisfactory explanation for how the bone, stone and charcoal materials came to be where they were (Fig. 22.1). The fired rock is an indication that the remains are cultural. The sparseness of remains, their wide scattering, the mixture of heavy (rock and bone) and light (charcoal) materials, together with an absence of medium weight or very small materials (chipped stone) all combine to suggest that this is neither a primary deposit like the other Sjovold occupations layers, nor a typical interlayer deposit with materials clearly derived from layers above and/or below. The narrow range of vertical distribution, well separated from occupation layers above and below, and the broad horizontal distribution are the main reason we have identified this as a separate layer. Yet, when we looked closely at photographic records and planviews of Layer XVIII we could see that some of the remains were on the edges of a large infilled animal den, part of which occupied the south-central part of XU 4. Those specimens may have been intrusive. It was also possible that some pieces were on the bottoms of the smaller burrow system along the north edges of XUs 5 and 6. Furthermore, we concede that some material could have been from the lowest parts of the roasting trough in Layer XVII. This possibility would especially apply to materials in the northwest part of XU 5 and the northeast part of XU 6.

At a glance these possibilities seem to encompass most of the Layer XVIII cultural materials. However, they do not account for one bone fragment in the northeast corner of XU 4, or for a large bone fragment and several pieces of charcoal which were found on the same grey/brown substratum of deep profiles 3 and 4, a short distance to the south and west of our excavation units. In these instances, there was no sign of animal disturbance or overlying cultural features. Thus, there must be another explanation for the presence of at least some of the materials in Layer XVIII. Trampling seems unlikely because of the very solid nature of the clayey silt deposits. It would not be easy to trample objects into such sediments unless they were very wet, and then there should be evidence for trampling in the form of interruptions of the lines of microstratigraphy which are apparent between layers XVII and XVIII. We did not see such interruptions. Two other possibilities are that: (1) the materials were redeposited by processes such as slope wash, or ice push/rafting from primary deposits elsewhere; or (2) the materials were on the remote fringes of an activity area we did not expose. Given the sparse nature of our data we have not been able to decide among the possible explanations for

Table 22.1. Coarse rock from Layer XVIII.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
sandstone	1	1	-	2	251	739	-	990
syenite	-	-	2	2	-	-	157	157
unidentified	1	-	-	1	26	-	-	26
Total	2	1	2	5	277	739	157	1,173

Layer XVIII materials and, therefore, leave the matter unresolved.

Rock

All five pieces of rock are fire-broken (Table 22.1). Sandstone is predominant, a material which showed only the smallest trace in Layer XVII. Next is syenite which was not represented at all in the Layer XVII sample. On the basis of this small sample it is unlikely that Layer XVIII rocks were derived from Layer XVII.

Faunal Remains

Three of seven bone fragments exposed in Layer XVIII were embedded the north walls of XUs 4 and 5 and were not collected. One of the four collected specimens is missing.

Bison, NISP=2 (31.2 g): humerus shaft, ulna ⊙. The ulna is from a juvenile bison, whereas the humerus is probably from an adult. The latter has been gnawed by a carnivore and is superficially etched by rootlets.

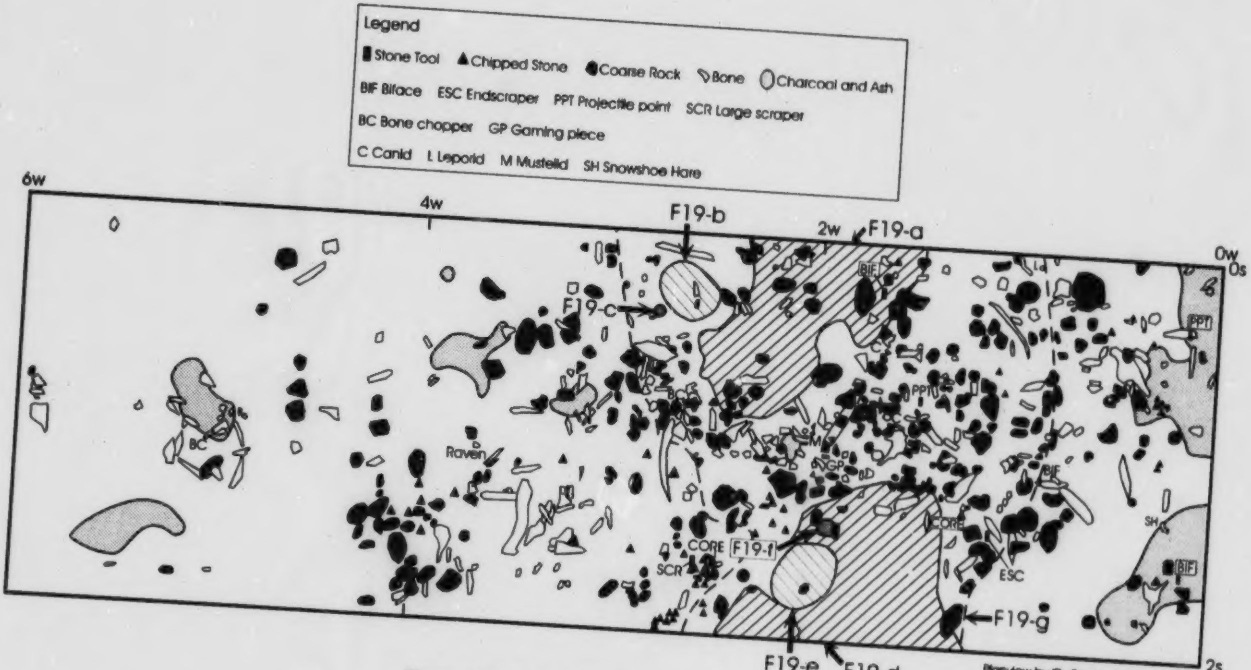
Unidentified mammal, n=1 (0.8 g): fragment less than 1 cm long.

Interpretation of Layer XVIII

In view of the sparseness of cultural materials and doubts about their context, it might have made sense to abolish the layer and merge the remains with an enlarged interlayer below Layer XVII. However, this would have meant re-numbering the lower layers, which we did not wish to do since we have already established the layer designations elsewhere with references to radiocarbon dates and summaries of contents. Therefore, we are perpetuating the designation, Layer XVIII, while acknowledging that the cultural remains are sparse and in a dubious context.

Interlayer XVIII/XIX

Interlayer XVIII/XIX is generally about 28 cm in thickness, but at 0n2w it extends between 321-352 cm BS. No cultural materials were seen in the interlayer during excavations, however, the interbedded clays, silts and sands were discarded without screening.


Legend
■ Stone Tool ▲ Chipped Stone ● Coarse Rock Bone ○ Charcoal and Ash
BIF Biface ESC Endscraper PPT Projectile point SCR Large scraper
BC Bone chopper GP Gaming piece
C Canid L Leporid M Mustelid SH Snowshoe Hare
6w
4w
2w
0w
0s
2s
F19-a
F19-b
F19-c
F19-d
F19-e
F19-f
F19-g
BIF
PPT
BC
Raven
M
GP
CORE
SCR
ESC
SH

Planview by ID, Corel rendition by REM

Figure 23.1. Planview of Sjovold Layer XIX.

Chapter 23

Layer XIX: A Pelican Lake Summer Camp

Introduction and Planview

Layer XIX, a dense Pelican Lake occupation dating between 1750 and 1450 BC (cal 2700-2400 BP; Table 3.6), lies at a depth of 352-363 cm BS at 0n2w. Two substantial hearths and several related features, including considerable coarse rock, broken bone, chipped stone debris, and several tools, were exposed in an area of 11 m^2. The reference position, 0n2w, lies in a shallow depression at the center of a slight crest on the occupation surface, a crest whose maximum heights are 348 cm BS at 0n3.25w and 347 cm BS at 0n1.5w. From those points the surface slopes gently downward to the west (7:325), east (4:150) and south (9:325) and, presumably, gently upward to the north (not directly observed). The greatest thickness of the occupation layer, up to 13 cm, coincided with the crest on the occupation surface and resulted from dense hearth accumulations in that area. Average thickness was about 8 cm. The occupation lies at the base of a deposit of buff-coloured sandy silt, just above the contact with underlying deposits of interbedded silt and clay. In most places the layer was defined solely by the presence of occupation remains since variations in natural soil colour and texture were extremely subtle above, immediately below and within the layer. Part of a clay-filled animal den, extending almost straight downward from Layer XV, had removed about 1600 cm^2 of the occupation surface from the south edge of XU 4. Similarly, a large sand-filled burrow extending downward diagonally from the northwest corner of XU 6 may have removed a small portion of the occupation surface or may have passed just beneath the occupation layer. The balance of the exposure bore no perceptible evidence of burrowing. Layer XIX was trowelled and screened in five levels, and all recovered materials were saved for analysis. Interlayer XIX/XX, extending 363-366 cm BS at 0n2w, averaged about 4 cm in thickness. The top 2 cm were trowelled and screened in one level. The only cultural materials encountered were bone, ash and scorched earth associated with the bases of features F19-e and F19-f which are reported with materials from Layer XIX. The bottom 2 cm were stripped off and discarded without screening.

The Layer XIX planview (Figs. 23.1, 23.2) is so littered with features and artifacts that we have limited its labelling to feature numbers, stone and bone tools, and non-bison faunal elements. Two bifaces, an endscraper, two projectile points, and a large scraper can be seen on the planview along with two bone choppers and a gaming piece. A mustelid (marten or fisher) canine tooth and two canid (wolf, dog or coyote) elements occur in the dense scatter between F19-a and F19-d. Near the north edge of XU 4 is a leporid (rabbit or hare) bone, and a snowshoe hare mandible occurs in the edge of a charcoal patch in the southeast corner of XU 4.

Table 23.1. Features in Layer XIX.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F19-a	surface hearth	35s210w	>90	85	11
F19-b	hide-smoking pit	27s267w	29	30	ca.19
F19-c	stake mold	41s284w	5	6	>16
F19-d	surface hearth	165s170w	>80	>127	12
F19-e	hide-smoking pit	168s202w	33	33	20
F19-f	stake mold	142s190w	7	8	15
F19-g	hearth drag/discard	90s175w	>200	230	11

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

Features

Feature 19-a (Fig. 23.1, Table 23.1), an elongate surface hearth, was one of two focal points in Layer XIX. The southern part of F19-a, perhaps a little more than half, was exposed by our excavations. That was composed of three layers. Uppermost was a 4 cm thick zone of white ash bearing a few fragments of bone and fired rock. Ash was thickest in an area about 75 cm in diameter on the southern lobe of the feature. A middle layer, about 4-6 cm in thickness, extended across the whole feature and consisted of black/grey soil containing powdered charcoal, small chunks of charcoal, pockets of ash, more than 300 pieces of fired rock, nine small pieces of baked clay, six pieces of chipping debris, including a core on the northwest margin, several pieces of bone in various states — charred, calcined and uncharred — and two stone tools, a biface knife lying on the northeast side of the feature and a crude scraper on the southwest. Stone and bone materials tended to be clustered in three areas: the northeast and southwest edges, and from north center to the west edge. The bottom layer, 2-3 cm in thickness, was simply brown/red soil. It was most clearly evident beneath the southern lobe, directly below the thickest part of the ash layer, indicating that this area was subject to slightly more prolonged or intense heating.

Rock heating was an important function of F19-a. Presumably the heated rocks served a nearby meat boiling operation(s), but it may also have been used for meat or bone roasting. Some 458 pieces, representing 12 different rock types weighing a total of 17,576 g, were found within the hearth. All but a few pieces showed evidence of firing; much of the rock was in an advanced state of disaggregation. Clustering of larger pieces toward the edges of the hearth together with a general smallness of fragments and diversity of rock types are all attributes of a rock-heating hearth. The more substantial quantities of fired rock outside the hearth are further evidence for the importance of this function. In addition, the hearth served as a focus and, to a small degree, as a disposal area for a diverse set of fireside or nearby activities which we will come to later. In the meantime we wish to draw attention to interesting aspects of the hearth itself.

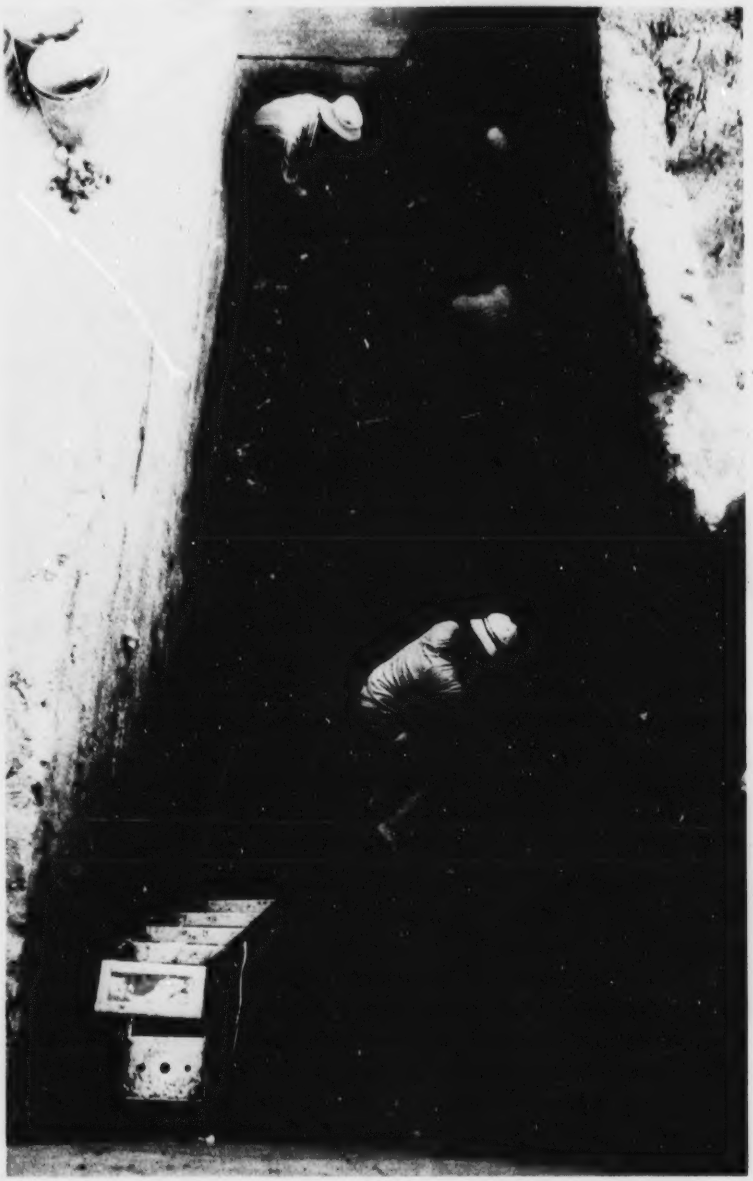


Figure 23.2. Layer XIX viewed from the west. Hearth F19-a extends from the left (north) wall surrounded by the hearth drag/discard feature (F19-g). RSM #EiNs-4:80-279 CT.

Figure 23.3. Pedestalled and sectioned hide-smoking pit (F19-b) and associated stake mold (F19-c). RSM #EiNs-4:80-272 CT.

The survival of deep ash over the southern lobe of F19-a is remarkable. It reflects a complete, undisturbed late phase of burning involving a substantial amount of fuel. The presence of charcoal in the middle layer indicates that wood was at least part of the fuel, and may have been the main fuel throughout the life of the hearth. However, the shear quantity of top ash coupled with a relatively shallow subsurface zone of oxidized earth makes us suspicious that buffalo chips (dung) contributed substantially to the fuel, particularly in late stages. The matter of ash survival also raises questions about the environment. A thick topping of ash implies an absence of wind during occupation, and ash-preserving conditions immediately following. One might imagine a light rain or snowfall to fix the ash in place after the last burning and, soon after that, a gentle burial.

The presence of nine small pieces of baked clay within F19-a is also unusual. Such an occurrence was not observed in any other Sjovold hearth, although additional pieces of baked clay were found in a hearth drag and discard area (F19-g) between F19-a and F19-d. Generally, the baked clay takes the form of flattish round-edged globules with irregular pocked, pitted, grooved and folded surfaces. Most are two cm or less in length. One of the larger pieces has a shallow channel on its

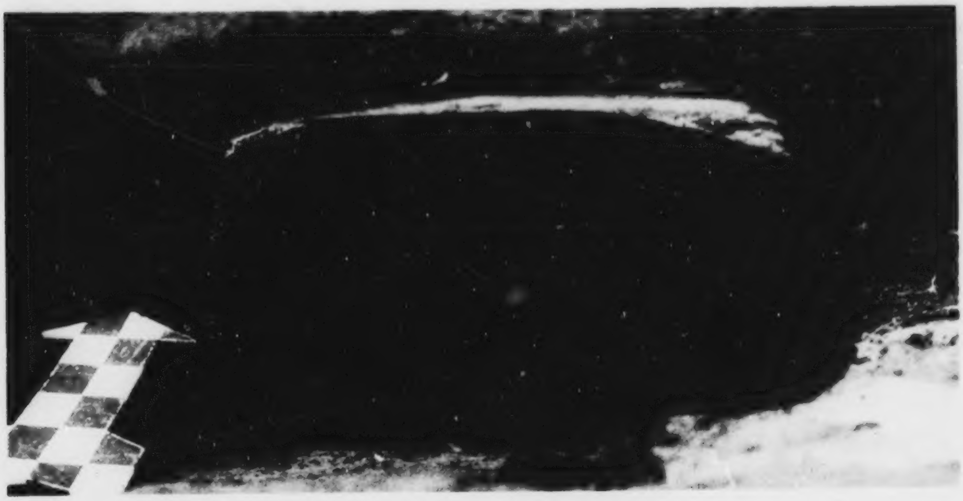


Figure 23.4. Profile view of hide-smoking pit (F19-b). RSM #EiNs-4:80-274 CT.

flattest face giving it the appearance of having been pressed against a thumb-sized stick. There seems little doubt that these pieces entered F19-a as clay and underwent their baking within the hearth. Potential explanations are: (1) they are clay trimmings resulting from pottery manufacture (unlikely; no pottery found in the layer and the occupation dates at least one half millennium before the earliest pottery known for the region); (2) they are bits of daub from a wattle and daub structure (unlikely; no substantial pieces found and no other evidence for such a structure); (3) they are trimmings from a clay-wrapping used for baking something in the fire (possible; but no larger pieces of baked clay found in the layer); (4) they are bits of clay which adhered to rocks brought to the hearth from the creek or river bed (possible; but no smooth or sharp angled surfaces); (5) they are bits of adhering clay removed from a digging tool used to excavate F19-b or F19-e and which penetrated the sticky clay at the top of Layer XX (our preferred explanation).

Feature 19-b was a small pit filled with powdered charcoal and ash-infused soil and situated about 10 cm northwest of the southern lobe of F19-a (see Figs. 23.3-23.4). In planview it was rounded and slightly oblong with a long axis pointing southeast toward the center of the southern lobe of F19-a. In east-west section the west wall was vertical, the base quite irregular with the deepest part about center, and the east wall sloped outward at an angle of about 35°. There was some variance in the contents of the pit. The deepest basal cavities were filled with jet black sediments, while the upper or effective basal level was marked by a layer of rusty red sediment surmounted by a small mound of greyish sediment. Above that the bulk of the pit was filled with jet black sediment here and there tinged grey. No bone or stone was included. The mouth of F19-b was about 3 cm higher and separated from ash on the nearby fringes of F19-a by a collar of buff-coloured soil. The superposition with respect to adjoining F19-a indicates that F19-b was created after F19-a had been subject to substantial use. This difference in age could be interpreted as separate occupations. However, a case can also be made for F19-b being a late phase of the same occupation as F19-a. The superpositioning might have been due to spilling earth excavated from F19-b around its mouth. On nearby excavation profiles we saw that F19-b was situated at the highest point of the surrounding occupation surface. The deepest part of F19-b was approximately equivalent to the deepest part of F19-a.

Another relational consideration is similarity in the positioning of F19-b with respect to F19-a compared to the position of F19-e with respect to F19-d. In both cases a pit about 30 cm in diameter was near the edge of an adjoining hearth. One could infer that the hearths had an influence in the placement of the pits. There are other relational factors which may also be interpreted as evidence for contemporaneity of the F19-b and F19-e pits with the other major features in the layer. For example, baked clay found within hearth F19-a and feature F19-g may have been derived from the bottoms of F19-b and F19-e. In addition, fragments of coarse rock from the bottom of F19-e match other pieces of rock found in F19-g (one piece actually lay on the south edge of hearth F19-a). We think that these considerations, while inconclusive, tip the balance in favour of roughly contemporaneous relationships among all features in Layer XIX, and we frame the rest of our interpretations in the light of that proposition.

F19-b compares favourably with historically recorded smudge pits used by North American Indians for hide smoking (cf. Binford 1967). The size (30x29x19 cm) falls within the observed range; the shape of the mouth, oval, is similar; the contents, carbonized organic materials, are indicative of combustion in a reducing atmosphere; and the contents do not appear to have been disturbed after burning. F19-b was very near to hearth F19-a, a possible complicating factor in the F19-b interpretation. However, if the F19-a hearth was partially covered by backfill from F19-b and if it had burned down and was covered by ash, its heat may have been lowered or buffered enough to be inconsequential to the operation of F19-b. Moreover, warming or drying of soil on the periphery of the hearth may have made excavation of a small pit easier there and may have been a reason for situating it in that particular position. Thus, our interpretation is that F19-b was a smudge pit used for smoking hides.

The shape of the pit may tell something about how it was excavated. The vertical west wall which was opposed to a decidedly sloped east wall may be evidence for rapid excavation with a digging tool. One can imagine that the west wall was where the tool was driven into the ground so that a clod(s) of soil could be levered out leaving a sloping wall on the east. The irregularities on the floor of this hole also tend to support this mode of excavation, probably followed by scooping out of the loose dirt by hand. Had the hole been excavated with a smaller tool, one would expect to see all the sides closer to vertical. Returning to the hide smoking function, one wonders what method was used to suspend the hide above F19-b. F19-c, a small adjoining feature, may hold the answer.

Feature 19-c was a very small and apparently deep hole filled with jet-black carbonized material. We did not recognize this feature during excavations. Consequently, most of it was removed without record as a result of making a section pit through the south half of F19-b. Fortunately, the basal part survived in photographic records allowing us to discover the feature belatedly and to describe at least its basal parts. The same records allow us to comment that there were no other similar features on the peripheries of F19-b. The base of F19-c was situated about 8 cm beyond the southwest edge of the base of F19-b. It was oval in plan, about 6 cm in greatest diameter, and its long axis was oriented toward the center of F19-b. It was apparently dished in profile and the bottom was at a level equivalent to the deepest reaches of F19-b. We do not know its true height, but, presuming that it extended upward to about the same level as the mouth of F19-b, one can estimate an overall depth of about 19 cm.

Our suspicion is that F19-c was a stake mold, a hole which held the base of an upright stake. The stake would have been about 4 cm in diameter and may have extended as much as 1.5 to 2 m above the level of the occupation surface. It may have been slightly inclined so that its upper reaches extended over the center of F19-b creating a firm support from which a cone-shaped hide could have been suspended for smoking. Such a device is one of four means known to have been used by North American Indians for suspending hides over smoking pits: (1) a small dome or tipi-shaped framework of withes over or around which the hide was wrapped; (2) a tripod of poles from the crotch of which a cone-shaped hide was suspended; (3) an inclined post stuck into the ground beside the pit for suspension of the hide; and (4) hand-holding the hide over the pit (cf. Binford 1967; Fowler 1989:79). Alanson Skinner (1914:83) made a brief description of Plains Cree hide-smoking which is particularly apt to the interpretation of F19-c:

> … for moccasin leather or tenting [the hide] still had to be smoked. To accomplish this the skin was sewed in a bag; reversed, the bottom slung from an inclined stick or a tripod, and the top pegged down about a little hole in which a punk-wood fire burned. In winter, when it was impossible to dig a hole, the punk fire was made in a kettle suspended under the inverted bag.

The fact that the base of F19-c, the supposed stake mold, was also filled with carbonized organic material is curious. It seems unlikely that F19-c could have been burned by the smudge fire in pit F19-b. However, the carbonized fill may have been due to incidental heating of the stake as a result of contact with hot coals of hearth F19-a. Perhaps, after the hide smoking had been finished, the stake was left in place and became part of a meat drying rack over hearth F19-a. Alternatively, it may be that the stake was extracted and that coals from F19-a fell into its hole. Either way, this line of reasoning places the operation of F19-b and F19-c during the life of hearth F19-a.

Feature 19-d was a large surface hearth centered about 175 cm southeast of the center of hearth F19-a. Only the northern part of F19-d was exposed in our excavations. It was rounded and elongate with a south-southwest to north-northeast orientation. The hearth was composed of two layers. The upper layer was a substantial lens of white/grey ash with a sprinkling of small pieces and patches of charcoal throughout. It was about 8 cm in thickness at center, but gradually thinned to 1-2 cm within

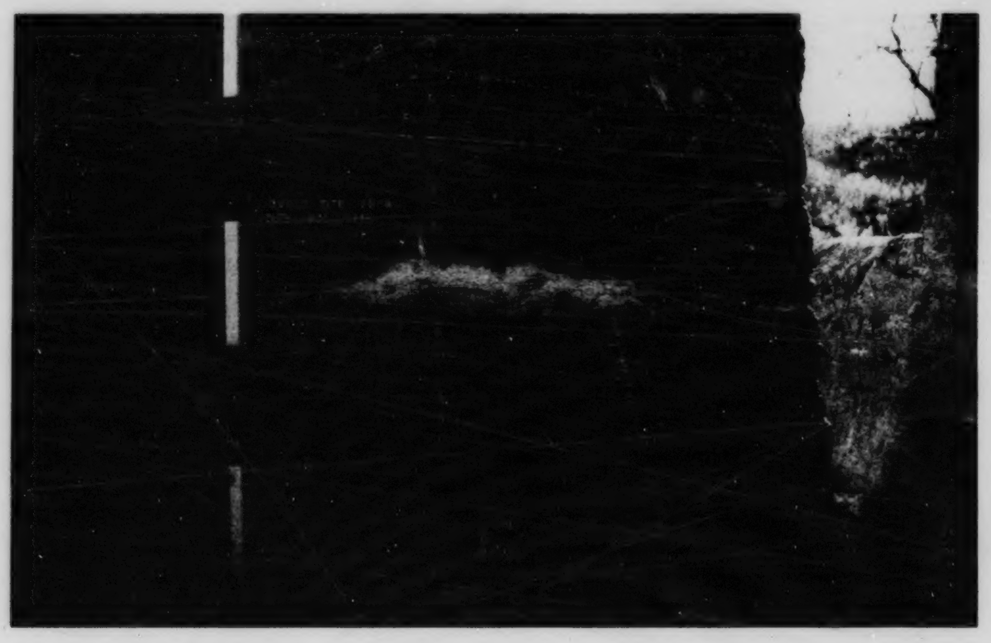


Figure 23.5. Profiles of F19-d hearth and the stratigraphically separate hide-smoking pit (F19-e) to the upper right. RSM #EiNs-4:80-344 CT.

a few cm of the edge and then abruptly disappeared at the edge (see Fig. 23.5). Around the margins of F19-d, both on and within this upper ashy layer, were several pieces of fired rock and bone fragments. The base of the upper layer was at the same level as the surrounding occupation surface. The contact between upper and lower layers was not level. Rather, the east side was 2-3 cm higher than the west. From this we infer that F19-d lay on a slight side-hill slope. In addition, an east-west section through the hearth showed the line of contact between upper and lower layers to have been dished downward 2-3 cm. We wondered whether this represented a natural hollow in the occupation surface or was due to hearth maintenance. Our suspicion is that the hollow was natural, but we have not found a satisfactory way to resolve the issue.

The lower layer of F19-d, a dished lens of fire-altered soil, was 4-5 cm deep at center. Toward the edges it thinned to 1-3 cm and then abruptly disappeared at the edges. This lower layer was generally composed of two sublayers, an upper member being charcoal and ash-infused soil, 2-3 cm in thickness, and a lower member being mauve-buff heat-coloured soil, 1-2 cm in thickness. In some areas, especially near the center of the hearth, the upper member of the lower layer was jet black. In other areas it was mainly grey and buff with numerous black spots and patches. We suppose that these differences may be a reflection of microenvironmental differences within the hearth, the deep central part being heated and taking on combustion residues from a more enclosed reducing atmosphere while the margins were roasted and took on combustion residues from a more open oxidizing atmosphere. It may also be that the fringes of the hearth were disturbed by the actions of bone and stone roasting.

Toward the northwest corner, F19-d had been penetrated by two small pits, F19-e and F19-f. Along its west, north and east margins was a fairly dense of array of hearthside debris, most of it lying within F19-g (the south side of F19-d was not exposed). As to the relationship between hearths F19-d and F19-a and the intervening feature F19-g, the three features formed a continuous plane of debris on the same occupation surface. We strongly suspect that they were all in operation at the same time. Thus, F19-d seems to have been a second focal point in a rather complex activity area.

The deep deposit of ash on the top of F19-d makes it evident that a substantial amount of fuel was thoroughly burned and relatively little disturbed. An obvious question is what was the fuel. Charcoal found in the ash was too small and powdery for identification. However, the depth of subsurface soil alteration might be described as moderate in comparison to the substantial amount of surface ash and that leads us to the suspicion that the fuel may have been a combination of wood and bison dung. Just what was being heated and/or smoked is another question. In contrast to F19-a, the center of this hearth was nearly devoid of stones. In total there were 65 pieces weighing 3140 grams within F19-d and the great majority were found within 10-15 cm of the edges. Therefore rock heating, although carried out to a small degree on the fringes of the hearth, was not a principal function. Why would another hearth be needed in such close proximity to F19-a? One possibility is that F19-a was a supplementary hearth used primarily for a special function such as smoking and drying meat. For example, Skinner (1914:82) described the steps which Plains Cree took in drying buffalo meat as: (1) cutting the meat into long thin steaks; (2) drying those for a period in the sun; and (3) finishing the drying on a rack over a slow but hot fire of buffalo chips. The bison meat brought to this camp may have been more than was needed for immediate consumption and an extra hearth may have been needed to accommodate the meat drying needs of the occupants.

Feature 19-e was a small pit filled with ash, charcoal, rock and bone fragments. The mouth of the pit was engulfed by and slightly higher than hearth F19-d. The pit penetrated the full thickness of F19-d and extended a few cm below into a bed of clay. The midsections of the pit were entirely surrounded by (and almost indistinguishable from) the ash, charcoal and other debris of the hearth. F19-e was oval in plan with a long axis that measured about 35 cm and was oriented southwest to northeast. Its depth was approximately 20 cm, and its floor was slightly dished so that its deepest point at the center was about 5 cm below the base of its walls. The mouth of F19-e was at the same level as the top of the ash on the east side of F19-d. However, considering that F19-d sloped gently downward from east to west and that F19-e lay on the west side, the mouth of F19-e was actually 1-3 cm above F19-d.

Covering the mouth was a thin layer of powdery pieces of charcoal and wisps of ash. This charcoal and ash continued off the pit mouth leaving patches trending mainly to the south and southwest to an undetermined distance, but also northwest to a distance of about 50 cm. Around the mouth, underlying the patches of charcoal and overlying F19-d, was a 1-2 cm thick collar of buff-coloured soil. This collar appeared to be thickest at the mouth while thinning as it reached out and then disappearing about 10-20 cm from the mouth. In some places, where the collar of buff soil ended the overlying patch of charcoal seemed to merge with the underlying ash and charcoal of F19-d. From this we infer that the soil around the mouth of F19-e had been spilled there as a result of pit excavation, and that superposition of the pit mouth above the engulfing hearth does not indicate a significant difference in the ages of the two features. It does show, however, that F19-e was built and operated after F19-d was well established.

The contents of the middle parts of the pit were virtually indistinguishable from those of the central parts of F19-d, a black/grey mixture of powdered charcoal and ash with the odd piece of fired rock and bone. The basal 5-7 cm of the pit was filled with a mixture of ash, charcoal, fired rock, and charred, calcined and unburnt bone fragments. The predominant colour of this mixture was white-grey indicating the large amount of ash it contained. However, it also included 64 fragments of at least 5 types of coarse rock weighing 426 g, and 37 unclassifiable fragments of large mammal bone weighing 23.2 g. Out of the bone fragments, 21 were calcined, 7 were charred and 9 were unburned. One of the pieces of coarse rock at the base of the pit was a distinctive banded gneiss, matching similar pieces found among the debris between hearths (in F19-g). A fired cobble of a similar material was also found in the northwest part of hearth F19-d.

Like F19-b, F19-e reveals strong similarities to North American Indian hide-smoking pits, specifically in respect to dimensions and shape. The association of another small deep pit (F19-f), only 8 cm to the north, adds another piece of supporting evidence to the analogy and, therefore, we are inclined to believe that F19-e was made and used for hide-smoking. Nevertheless, there is also some discordance between the attributes of F19-e and those of historically recorded hide-smoking pits. Specifically, F19-e was filled with ash from the top to the bottom. Although there were some black crumbs and fragile chunks of charcoal here and there through the pit, except for the thin layer of charcoal on the mouth, the contents were overwhelmingly white/grey. This suggests that the contents had been not been burned in a closed reducing atmosphere. Minor additional differences between F19-e and F19-b include the slightly larger, slightly deeper size of F19-e, and the smoothly dished floor. We can think of two different explanations for these differences.

The first is that the pit experienced several episodes of use and that its uses varied. For example, it might have been built and used as a hide-smoking pit, then cleaned out and used as a roasting pit, then topped up with smudging fuel and used once again as a hide smoking pit. That would explain the smoothly dished floor (clean out after first hide smoking episode), the ash and charcoal mixed with fired rock and bone fragments at the base (residue from roasting coals), the mixed black/grey combustion materials in the mid-section (recharge of burning fuel from a hearth), and the top layer of charcoal (smudging material). The roasting episode would involve putting some medium to small thing(s) into the pit to be roasted, covering it or them with hot coals, then retrieving the roasted material and leaving some of the covering ash in the base of the pit. As to what might have been roasted, one's mind turns immediately the small game. However, the bone fragments in the pit appear to have been from a large mammal. Another possibility could have been the roasting of tubers such as Indian turnips. Mandelbaum (1979:74) describes one of the Plains Cree methods for preparing Indian turnips: "They were prepared in a shallow pit dug in the tipi floor. The roots were placed in the hole, covered over with coals, and left to bake overnight."

An alternative explanation is that the feature served only as a hide-smoking pit, but its situation prompted some differences in construction. Being entirely within hearth F19-d, the excavation of a pit would have required some scooping since the ash of F19-d could not have been easily removed only with a digging stick. That may have produced the smoother base. The mid-sections of the pit, being composed entirely of F19-d hearth debris, were probably unstable and some part of the wall may have collapsed into the base of the pit and been left there. On top of that new coals and fuel may have been dragged from a hot part of the hearth creating the contents in the mid-sections almost indistinguishable from the hearth itself. Finally, smudging materials would have been placed in the top of the pit to create the desired smoke. We prefer this second interpretation, because it is simpler but seems to explain the observations.

Feature 19-f, a pit about 7 cm in diameter and 15 cm in depth, was situated about 8 cm north of F19-e. Its mouth was at the same level as the mouth of F19-e and its base was almost as deep. A thin slab of plano-convex rock, rested against the east wall of the mouth, convex side against the wall, one sharp end projecting down into the pit and the other extending about 2 cm above the mouth. The only other contents for the first 6 cm of the pit were mottled buff-grey soil and the odd small smear of powdery charcoal or wispy ash. Below 6 cm the pit was filled solid with ash and charcoal to a depth of about 10 cm. From there to the bottom, its contents were mottled buff-coloured soil containing the odd particle of charcoal or ash.

F19-f was similar to F19-c in respect to shape and position near a larger pit and is interpreted as having had the same function, namely, as having been the hole in which a stake was planted, slightly inclining over F19-e, to provide a firm post from the top of which a hide could be suspended. The stone in the mouth of the hole was probably used as a wedge to secure the stake. The stratified sediments within the pit may have been a consequence of withdrawal of the stake and subsequent natural backfilling — first with dirt placed in the hole while the stake was still in place, then with ash and charcoal of F19-d from collapse of the walls, and finally with slope wash and earth from natural burying processes. The position of F19-f, completely within the boundaries of F19-d, is curious. Evidently, the ashes were not still hot or the heat was not sufficient to deter this placement. There might have been a significant advantage to digging at this location. Perhaps the soil there was softer.

Feature 19-g was a jumble of debris lying between and spreading around hearths F19-a and F19-d. The major constituent was fired rock weighing approximately 35,000 g. There was also a substantial amount of broken bone, mainly bison and unidentified mammal, weighing roughly 2,600 g; a few pieces of stone chipping debris, mostly along the northwest margin of F19-d; four bone gaming pieces; three projectile points, two in the east central area and one on the west edge of hearth F19-a; one fragment of a large biface on the east central edge, and a broken endscraper on the southeastern part. All of this was seated in a mottled grey-brown soil matrix which was sprinkled with charcoal and ash. The thickness of the feature varied from about 6 cm to about 10 cm depending on the concentration of debris, the thickness of rocks, and small undulations in the occupation surface. The base was approximately equivalent to the bases of ash layers in adjoining hearths. Thus, the mean depth of F19-g was equivalent to that of the surrounding occupation surface with slight projections both above and below. The margins of the feature were difficult to define since debris trailed away in all directions. Hachures in Figure 23.1 mark areas in which charcoal within the soil matrix was densest, an area largely coincident with the densest concentrations of stone and bone near the hearths. Some of the debris in outlying areas might properly be included with F19-g. However, what is within the outlined area is probably sufficient to allow interpretation of the feature. Beyond the limits of F19-g the occupation surface was generally a buff-yellow colour. There were a few outlying charcoal patches, some associated with other kinds of debris, some not. They are marked with slashed lines on Figure 23.1 but are not necessarily parts of F19-g.

The accumulated debris in F19-g is difficult to interpret, especially without seeing the areas immediately north of hearth F19-a and south of F19-d. Our guess is that F19-g is a result of hearth drag from F19-a and discard (a toss zone) from activities carried out by people sitting on its eastern and western peripheries. The hearth drag would have been due to the pulling of hot rocks from the hearth, primarily F19-a, so that some could be picked up with tongs for stone boiling while others could be left in place as a hot platform for bone roasting. The discard function could have been served as people, sitting on the peripheries, carried out such activities as breaking bones for marrow, stone boiling, replacing broken arrowheads, manufacturing and retouching chipped stone tools, meat cutting, hide working and gambling.

Other Observations. We think that there may be additional patterning among debris scattered west of the central concentration of features. For example, the abundance of chipped stone debris on the west edge of F19-d was part of a slightly larger concentration which extended about 50 cm west along the northwest corner of the hearth. That may be indicative of a fire-side sitting position at which someone carried out stone chipping and other activities. About 50 cm further west was a circular cluster of fairly large bone fragments, possibly discard from a cooking operation. Another 50 cm west, on the southwest border between XUs 5 and 6, was a cluster of fairly large fired rocks, possibly indicative of a nearby stone-boiling operation. Beyond that, in the center of XU 6, was yet another cluster of bone fragments, possibly additional residue from a bone boiling operation. XU 6 contained much more barren space than the other excavation units. Some of that space may have been used for tasks such as fleshing hides. A metapodial tool resembling a hide flesher was the only tool found in that unit, but this tool may have served other purposes such as dismembering a carcass or even digging holes for stakes at F19-c and F19-f.

Table 23.2. Coarse rock from Layer XIX.

Material	Number				Weight			
	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
amphibolite	12	7	1	20	1,678	301	2	1,981
andesite	22	53	13	88	662	1,514	528	2,704
anorthrosite	-	1	-	1	-	33	-	33
basalt	3	3	1	7	361	191	409	961
baked clay	8	9	-	17	63	17	-	80
chert	-	1	-	1	-	1	-	1
concretion	37	28	-	65	207	119	-	326
diorite	8	-	1	9	126	-	213	339
dolomite	-	1	-	1	-	28	-	28
gneiss	266	179	14	459	10,272	9,571	4,175	24,018
granite	509	175	10	694	19,822	9,360	1,562	30,744
grano-gneiss	69	171	1	241	4,728	6,469	12	11,209
limestone	3	26	-	29	29	567	-	596
mica schist	3	2	-	5	295	141	-	436
quartz	-	1	-	1	-	97	-	97
quartz porphyry	1	2	1	4	18	625	332	975
quartzite	6	25	7	38	160	1,959	634	2,753
sandstone	40	61	-	101	1,654	3,731	-	5,385
syenite	4	2	-	6	391	354	-	745
tuff	11	2	-	13	268	327	-	595
unidentified	99	56	6	161	261	377	96	734
Total	1,101	805	55	1,961	40,995	35,782	7,963	84,740

Rock

Layer XIX contained one of the densest concentrations of coarse rock in the site (Table 23.2), second only to Layer X. Unlike Layer X, the overwhelming majority of the Layer XIX rock showed clear signs of having been fired. Only a few pieces of andesite and tiny pebbles and pieces of other materials, a minute fraction of the total weight of rock, were exempt from fire-induced alteration. The dominant rock types (by weight) are granite (36%), gneiss (28%), grano-gneiss (13%), sandstone (6%), quartzite (3%) and andesite (3%). All are available in surface exposures along the valley slopes and river/creek beds within a stone's throw of the site. Moreover, the proportions of dominant rock types in Layer XIX are generally similar to proportions of the same materials in local sources (Dyck 1990). Therefore, it seems probable that occupants of Layer XIX collected rocks from nearby valley slope or creek/river bed sources randomly with respect to material type. Probable uses for the fired rock were stone-boiling, bone roasting and bone breaking. The average weight of Layer XIX rock is 43.2 g. This is close to averages from layers I (51.9 g), III (48.9 g), XIII (44.3 g), and XIV (50.53 g) where the size range was inferred to be a reflection of moderate disaggregation and use. The same inference is made for Layer XIX. The unfired andesite may be chipping debris from tool manufacture.

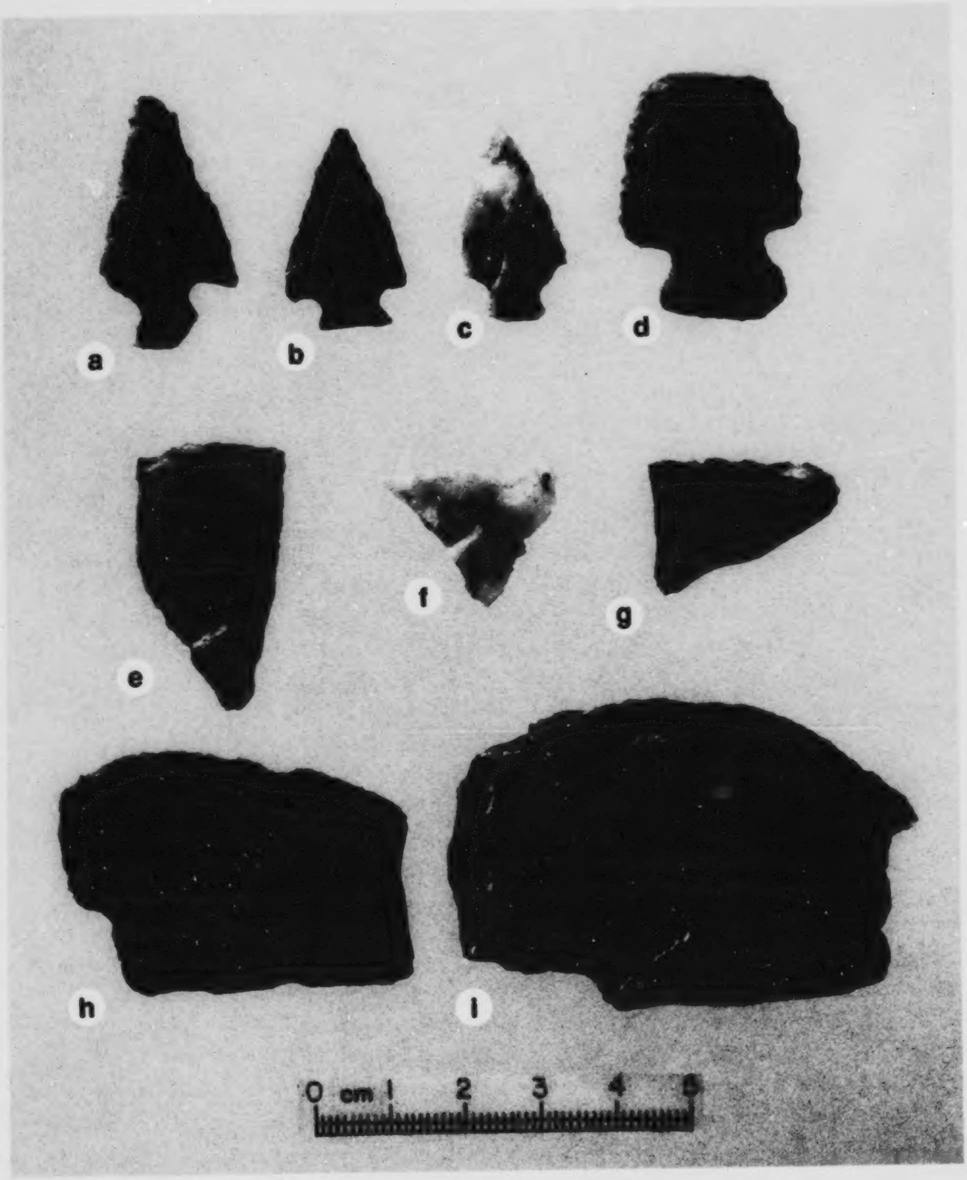

a
b
c
d
e
f
g
h
i
0 cm 1 2 3 4 5

Figure 23.6. Projectile points (a-d), endscraper (e), MURL (g), and biface knives (g-i) from Layer XIX.

The tiny unfired pebbles are a natural constituent of the soil. Baked clay included in this sample is from hearth F19-a and hearth drag/discard area F19-g, and was almost certainly deposited in the hearth as wet clay.

Stone Tools

Biface knives (n=3). Catno 7563, found on the east edge of hearth F19-a, is a small slab of dark brown petrified wood (Fig. 23.6, Table 23.3). One end is partly crushed, apparently a consequence of being the striking platform from which the slab was removed from a piece of parent material. The opposite end is a thin flat fracture face. One side has bifacial retouching along its whole extent including points of juncture with the ends. Retouching flake scars extend 3-7 mm from the edge. The material contains natural fault planes paralleling the edge which made flaking difficult and caused several step fractures. As a result, retouching was minimal, just enough to produce a straight, slightly sinuous, sharp, thick edge. In viewing the tool from either face, the retouched edge forms a gentle convex line. It shows signs of crushing toward the middle and light rounding and polish toward the ends. There are minute traces of red residue in some crevices near the crest of the edge, particularly toward the middle. There are also fine fibres adhering to crevice surfaces particularly near the striking platform end. The side opposite the retouched edge is flat and blunt, creating a natural backing. It appears that the tool has been used for cutting a tough bloody substance such as ligaments on a joint of meat.

Catno 7380, found about 75 cm east of the southeast corner of F19-g, is similar to catno 7563. It has one long, slightly sinuous, convex, retouched side with a natural backing or thick flat edge on the opposing side. Retouching along more than half of one face has been obstructed by a natural fault so that in that region retouching along one face is matched by a long cleavage scar on the other face. The edge itself is moderately crushed and worn in the middle and lightly rounded and worn on the ends. There are cream coloured residues and fragments of fibres in crevices along the retouched edge and, to a lesser degree, on the faces.

Catno 7376, found on the east central edge of F19-g, is a triangular edge segment of a broken biface. One of the fracture faces has a weathered appearance and bears a fairly thick smear of reddish-buff residue which may be blood. That surface probably existed when the tool was whole. The other fracture surface is curved. It starts out perpendicular to one face and exits on the opposite face at an angle of about 30° indicating that it was caused by a snapping kind of fracture. The retouched edge segment, only about 25 mm in length, was created by fairly regular flaking extending 7 mm or more away from the edge. The edge, itself, is moderately sinuous, nicked, lightly crushed, and lightly rounded and worn. There is a cream coloured residue adhering to crevices on the edge and faces. In places particles of soil and broken fibres are embedded in the residue. It appears that catno 7376 was also used as a cutting implement and that it broke as a result of being used in a levering fashion.

Table 23.3. Stone tools from Layer XIX.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
biface knife	7376	4	4.2	25	17	9	Knife River Flint	n	23.6g
biface knife	7380	4	30.3	62	41	9	petrified wood	y	23.6i
biface knife	7563	4	14.6	45	33	8	petrified wood	y	23.6h
endscraper	7780	4	5.5	36	20	7	silicified sediment	n	23.6e
large scraper	7287	5	283.3	106	71	25	andesite	y	23.7b
large scraper	7610	5	90.3	106	52	18	andesite	y	23.7a
MURL	7516	4	1.3	24	19	3	petrified wood	n	23.6f
projectile point	7361	4	3.8	33	25	6	silicified sediment	n	23.6d
projectile point	7436	4	1.4	27	14	4	petrified wood	y	23.6c
projectile point	7511	4	1.4	26	16	3	Knife River Flint	n	23.6b
projectile point	7710	5	2.3	39	18	3	Knife River Flint	n	23.6a

Endscraper (n=1). Catno 7780, from the southeast corner of F19-g, is a triangular flake of fine-grained grey/buff silicified sediment. It has steep unifacial retouching along two lateral edges which converge at a point. The opposing end has been broken off perpendicular to the long axis of the tool and perpendicular to both faces, producing an end section which is 20 mm long and triangular in profile. The surface is crazed and there are several "potlid" fractures on both ventral and dorsal faces indicating exposure to fire. The retouched edges are rounded and polished approximately from their midsections to their terminations at the broken end. The degrees of rounding and polish increase toward the broken end. Our interpretation is that catno 7780 is an endscraper missing only the working end.

Large scrapers (n=2). Catno 7287, found within the southwestern part of hearth F19-a, is a large decortication spall from an andesite cobble (see Fig. 23.7). One of its edges, about 75 mm in length, is naturally sharp and fairly straight. That edge has been lightly rounded and polished by a combination of light crushing and abrasion. There are creamy white and, occasionally, granular red residues adhering to crevices on both faces within 6 mm of the edge. The odd segment of white fibre may also be seen. Similar residues adhere to other edges and faces, particularly the cortical face. It appears that this tool was used for scraping or cleaving a soft, somewhat bloody, substance. Catno 7610, found among stone chipping debris a few cm west of the southwest edges of F19-g and F19-d, was similar to catno 7287. It is a smaller cortical spall, like a giant bifacial thinning flake. Its 105 mm long distal end, a naturally thin, sharp, gently convex edge, has been used as a scraping edge without resort to retouching. The edge is nicked and slightly broken at numerous places along its length and all the surviving prominences are rounded and polished at right angles to the edge. There is very little residue along the working edge, but a fair bit of chalky white residue, possibly calcium carbonate, adheres to both faces. Powdery rusty orange material, probably iron oxide, lies in some natural crevices. However, there is a considerable amount of white fibrous material adhering to the roughest part of the cortical face near one end. Thus, catno appears to have had a similar use in scraping a soft,

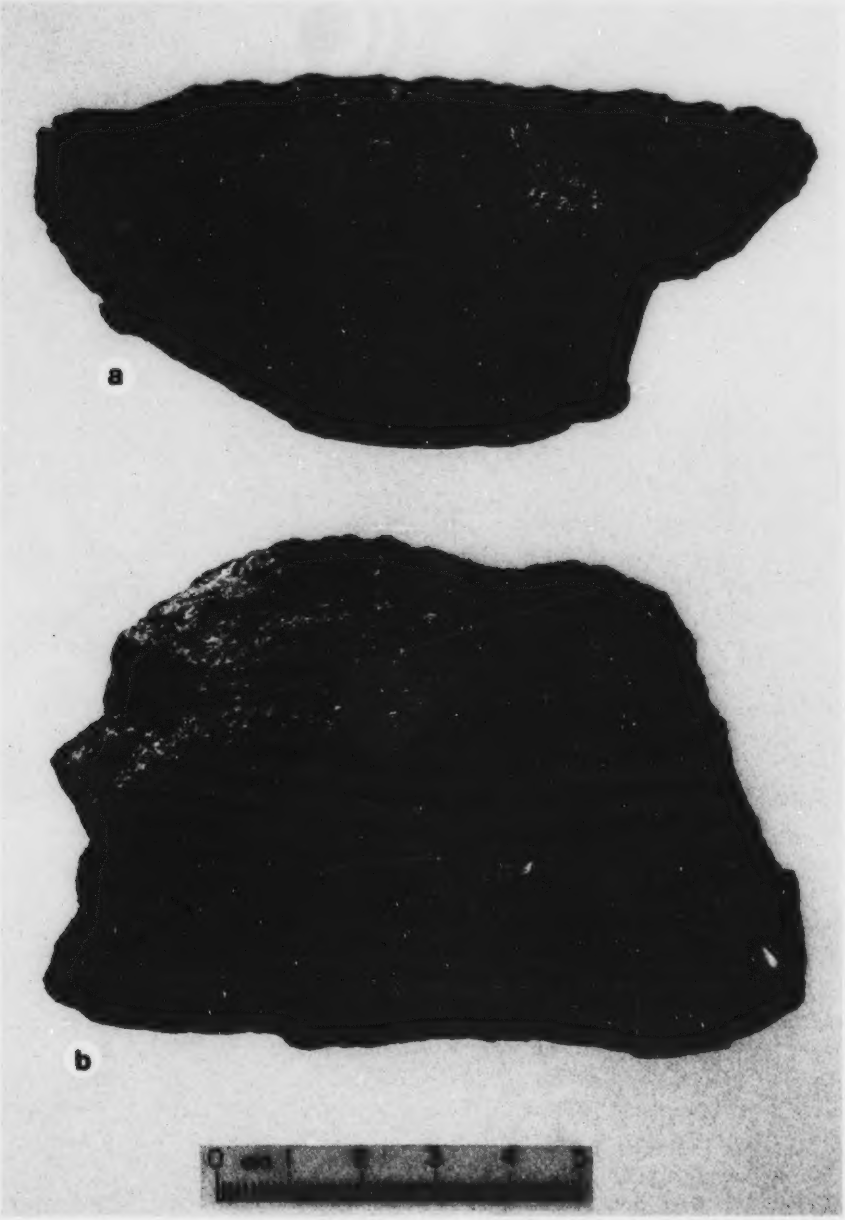

a
b
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Figure 23.7. Large scrapers from Layer XIX.

but apparently not bloody, material.

MURL (n=1). Catno 7516 is a thin expanding flake of white petrified wood with fine unifacial retouching along one side, and a missing distal end which appears to have broken off. The maximum dimension of retouch flake scars is about 1 mm and the length of the retouched edge, probably incomplete, is about 24 mm. The edge is roughly straight in planview and slightly curved in side view. It looks and feels sharp. In the step fracture crevices along the edge are buff-coloured residues and some fibrous mauve-red residues. Shiny black carbon residues are also found along the edge and on both faces. There is a small area of rusty red residue, about 2 mm square, on the ventral face almost touching the retouched edge. Another small residue is in a similar position on the dorsal face. It appears that catno 7516 was used as a small, razor blade-like cutting tool and then was discarded into a hearth, probably F19-d.

Projectile points (n=4). Although somewhat variable in form and size, all the projectile points (see Fig. 23.6) are classifiable to the Pelican Lake type (Wettlaufer 1955; Wettlaufer and Mayer-Oakes 1960). Catnos 7511 and 7710, both made of Knife River Flint, have straight sides, deep corner notches and straight, narrow bases. Both have been disabled by impacts on their points. Catno 7710 shows the greatest damage having lost the point and top half of one lateral edge, the base-notch juncture on the same side, and the tang-notch juncture on the other side. All of this damage probably occurred as the result of a single impact. Catno 7511 had similar but much less extensive damage. It lost the pinnacle off the tip and the basal edge. Although, at a glance, the point still looks whole, this damage apparently led to its discard. The most prominent residues on both points are particles of charcoal and ash indicating that both have been in a hearth. Catno 7710 was found in F19-g on the west edge of hearth F19-a and catno 7511 was in the center of F19-g a short distance south of F19-a.

A third point, catno 7436, appears to be complete but unusable because of faults in the material which could not be overcome during manufacture. This point is made of banded cream and buff-brown petrified wood. A large step-fractured flake has left an unsightly prominence in the center of one face just above the haft. This interfered with basal thinning and notching, and apparently could not be removed. Thus, the point was discarded almost complete, but unused. The place of discard, possibly also of manufacture, was about 75 cm east of the northeast corner of F19-g.

The fourth and largest point, catno 7361, is unusual for its material of manufacture, a semi-hard grey-green silicified sediment. Although certainly firm enough to be chipped, the material has a weathered clayey appearance. The tip has been broken off leaving a fracture which is transverse to the long axis of the point. The fracture surface has two pronounced transverse grooves which we suspect are indicative of breakage due to levering and snapping forces. The remaining portions of lateral sides, possibly altered by unifacial attempts at resharpening, are slightly convex. On one side the point of juncture between tip fracture and lateral edge is noticeably rounded and polished as if that juncture had been used as a graver after the fracture. The large deep notches have contributed to a narrowing of the base making it distinctly narrower than the body. The basal edge is slightly convex.

Table 23.4. Chipped stone debris, excluding cores, from Layer XIX.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
andesite	1	55	-	56	50.1	132.4	-	182.5
chert	5	14	-	19	5.2	7.0	-	12.2
Knife River Flint	8	8	-	16	8.9	3.2	-	12.1
petrified peat	47	104	1	152	73.1	227.8	0.2	301.1
petrified wood	18	41	2	61	22.1	141.6	3.6	167.3
quartzite	1	5	-	6	18.4	236.5	-	254.9
quartz	4	34	-	38	15.4	80.9	-	96.3
Swan River Chert	4	5	-	9	5.0	98.6	-	103.6
silicified sediment	-	4	-	4	-	44.0	-	44.0
unidentified	3	-	-	3	0.7	-	-	0.7
Total	91	270	3	364	198.9	972.0	3.8	1,174.7

An amber-brown to black residue occupies pores and crevices of about one third of both faces. There does not seem to be a clear association between residue and working edges as on many other artifacts. There are also particles of charcoal in crevices along the basal edge indicating that the point has been in contact with hearth debris. Catno 7361 was found near the center of F19-g.

Application of the Thomas (1978) discriminant classification equations indicates that two of the Layer XIX projectile points (catnos 7361 and 7710) were dart points, one (catno 7436) was an arrowpoint and the other (catno 7511) was too close to classify. This is consistent with findings at the Mortlach type site (Wettlaufer 1955).

Chipped Stone Debris

Layer XIX contained 1175 g of chipping debris exclusive of cores (Table 23.4). Three locally available materials dominate the collection: petrified peat (25.6% by weight), quartzite (21.7%), and andesite (15.5%). Three materials whose sources are suspected to be surficial deposits in southern Saskatchewan also made a strong showing: petrified wood (14.2%), Swan River Chert (8.8%) and quartz (8.2%). Additional materials of exotic or unknown source appear in trace amounts: silicified sediment (3.7%), chert (1.0%) and Knife River Flint (1.0%). The degrees of reduction cover a fairly wide range. Materials whose average weight falls into the large category (3.0 g or greater) include quartzite (42.5 g), Swan River Chert (11.5), silicified sediment (11.0) and andesite (3.3). Those in the middle category (1.0-2.99 g) are petrified wood (2.7), quartz (2.5) and petrified peat (2.0). The small category includes Knife River Flint (0.8), chert (0.6), and unidentified (0.2). This reflects a considerable range of chipping, from primary to tertiary reduction, and from initial manufacture to repair or sharpening of large, medium and small tools. Almost all of the material types represented

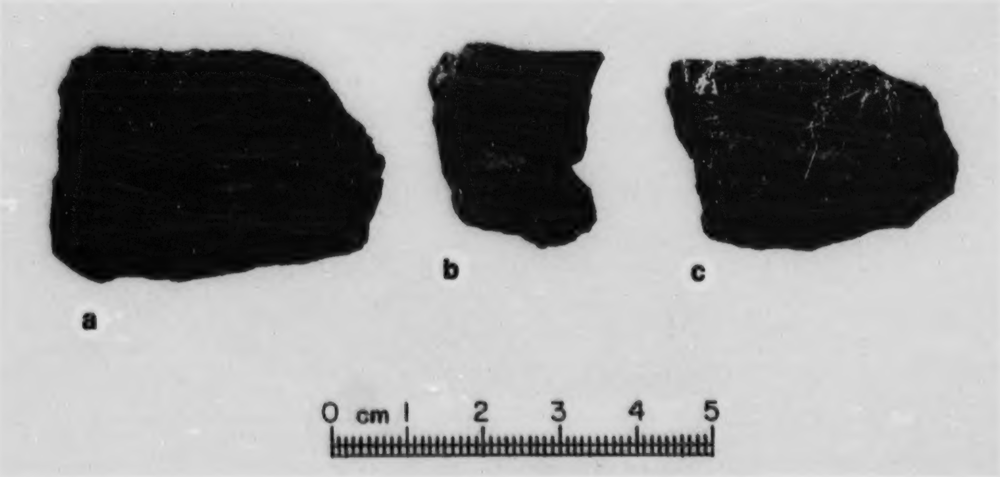


Figure 23.8. Chipped stone cores from Layer XIX.

by tools are also represented in the debris, a single endscraper being the exception. However, some debris materials were not represented among the tools. There were no tools of the most important debris type, petrified peat, and none of quartzite, Swan River Chert, quartz, or chert. This is not too surprising since much of the debris reflects new tool manufacture, tools which were probably still in good enough condition to be carried away at the end of the occupation. It is interesting to note that andesite, which is not an important chipping material in most other layers, is quite important here yielding a fair amount of debris and two large scrapers. On the other hand, Knife River Flint, an exotic material, follows the usual pattern, apparently arriving in the site chiefly as finished tools and being left either as finer retouching flakes or as damaged tools.

Three small bipolar cores representing as many material types were recovered in the layer (see Fig. 23.8). Catno 7552 (petrified peat, 13.1 g) was in F19-g, a little southeast of center. Catno 7285 (chert, 7.6 g) was in the ashy southwestern lobe of F19-a, and catno 7585 (petrified wood, 7.8 g) was among the chipping debris on the west edge of hearth F19-d.

Bone Tools

The bit of a humerus chopper was found in XU 5 (catno 7571, Fig. 23.9). The teres tuberosity is present on this piece, and its orientation shows that the chopper handle would have been the proximal end of the bone. Thus, the placement of the working edge in the thickest part of the humerus shaft is similar to that seen on a humerus chopper bit in Layer IV-V (Chapter 9), but the location of the handle is opposite. A complete metatarsal chopper occurred in XU 6 (catno 7681). It consists of the proximal half of a right metatarsal with the working edge formed on a bluntly pointed mid-shaft spiral fracture. The metatarsal can be re-articulated with a tarsal assembly from XU 6 that includes the calcaneus, tarsal 2+3, and tarsal C+4, but lacks the talus and tarsal 1. Such a composite tool would have resembled the serrated fleshers often formed on metapodials in historic times, with the tuber calcis of the calcaneus serving as a fastening point for a wrist strap that both stabilizes the grip and aids in applying force to the work (e.g. SIACAC 1974:12). We view the Sjovold specimen as a chopper rather than a flesher, because it lacks serrations and has a chipped working edge. This tool could have been used to dig holes for hide-supporting stakes at F19-c and F19-f.

Four small pieces of bone found in XU 4 are interpreted as gaming pieces or bone dice (see Fig. 23.10). They comprise two matched pairs

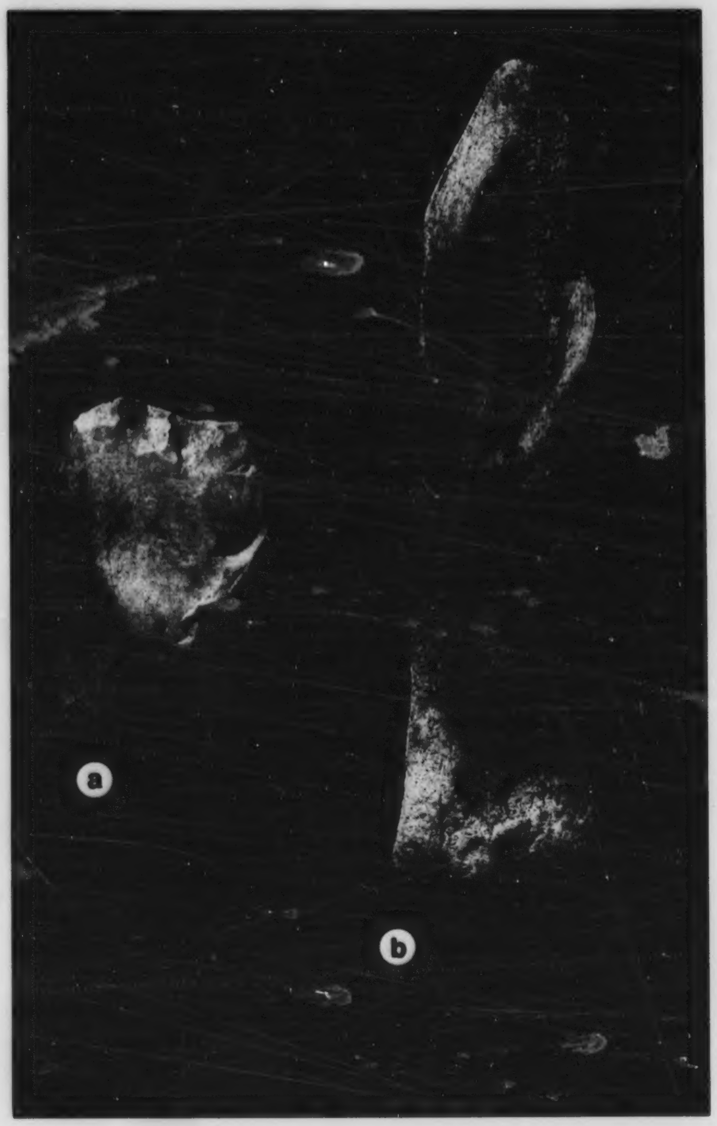


Figure 23.9. Bone choppers from Layer XIX.

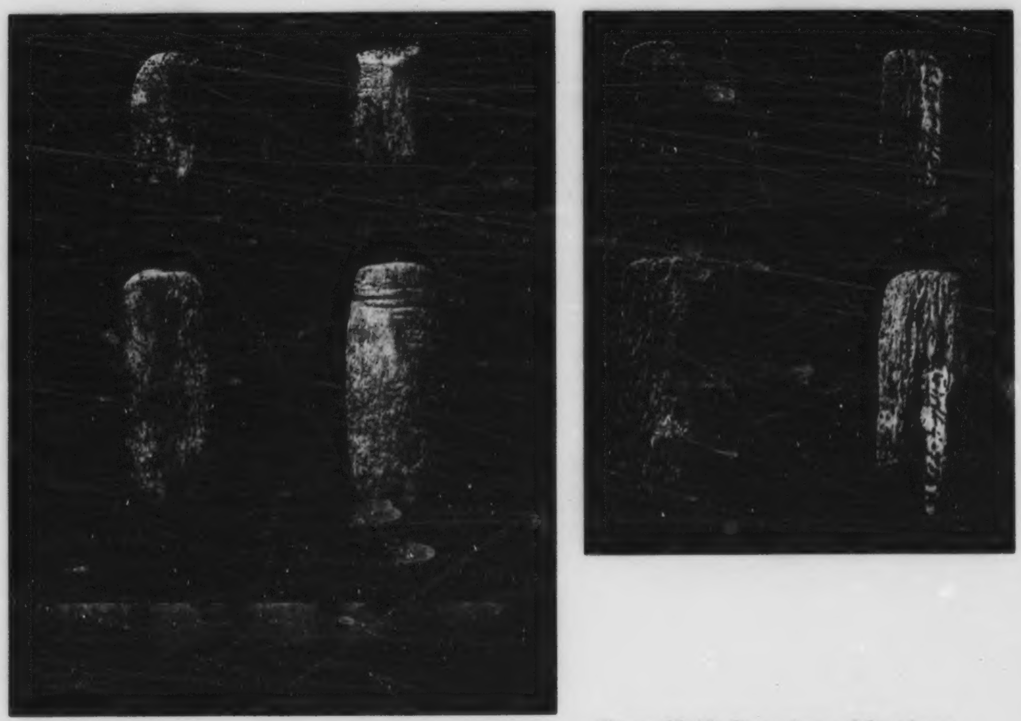


Figure 23.10. Two views of four bone gaming pieces from Layer XIX.

of bone rectangles that have been worked on all faces and edges. The larger ones (catnos 7558, 7741) measure 27 x 11 x 3 mm and 26 x 10 x 3 mm; the smaller ones (catnos 7592, 7741) measure 16 x 9 x 3 mm and 16 x 9 x 2 mm. The anatomical part(s) cannot be definitely determined, but they may have been made on rib shaft segments. Longitudinal striations on the cortical surfaces reflect shaping by a stone scraper. These are overlain by transverse scoring that appears near the ends of the rectangles as if to mark places for snapping shaped blanks. The edges and faces of the rectangles are rounded and smoothed by grinding. All four pieces retain bits of red pigment in the cancellous tissue as if they have been rubbed or sprinkled with red ochre. Bone dice were widespread in native North America and were well known among Plains Indians (Culin 1907).

Faunal Remains

A radiocarbon date (S-1769) on bone from this layer was drawn from the south-facing profile and did not diminish the assemblage reported here (Tables 23.5-23.7).

Table 23.5. Vertebrate remains from Layer XIX.

	Number				Weight			
Size, Taxon	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
6, Bison	36	50	21	107	1,530.2	2,221.3	1,036.1	4,787.6
5-6, mammal	95	69	19	183	716.9	583.0	235.8	1,535.7
4-5, Wolf, Dog or Coyote	2	-	-	2	27.1	-	-	27.1
4-5, mammal	1	-	-	1	0.6	-	-	0.6
3, Marten or Fisher	1	-	-	1	0.2	-	-	0.2
3, Rabbit or Hare	1	-	-	1	0.4	-	-	0.4
3, Snowshoe Hare	1	-	-	1	2.3	-	-	2.3
3, mammal	9	-	-	9	0.8	-	-	0.8
1, Deer Mouse?	-	-	2	2	-	-	0.1	0.1
-, mammal	1,240	949	436	2,625	686.3	575.5	145.2	1,407.0
Common Raven	-	2	-	2	-	3.6	-	3.6
Veery	-	1	-	1	-	0.1	-	0.1
Horned Lark	1	-	-	1	0.1	-	-	0.1
Bird	-	2	-	2	-	0.7	-	0.7
Total	1,387	1,073	478	2,938	2,964.9	3,384.2	1,417.2	7,766.3

Bison, NISP=107: see Table 23.6. Dentitions from Layer XIX represent at least four age groups, and post-cranial elements include bull (MAU=0.5), cow or calf (MAU=2.0), and calf (MAU=0.5). An old bull is represented by a mandible in age group 10-11, and a possible sub-adult bull is indicated by a distal tibia of intermediate size. The metatarsal chopper and its associated tarsals come from an adult bull. The cow or calf distal tibia and lateral malleolus probably comprised an articulated unit in XU 4. Also from XU 4 are radius and femur shafts with porous surfaces representing a very young calf.

Table 23.6 shows that all major body parts are present but that podials (including carpals, tarsals, metapodials, phalanges, and sesamoids) are markedly underrepresented. This pattern suggests selective retrieval for meat and marrow, and the remains are extensively processed for both of these foods. Seventeen of the bones, five of them charred, are associated with hearths F19-a and F19-d. Fragments of cervical and thoracic vertebral centra in hearth 19-a may represent the roasting of a neck, even though only two of the bones are charred. Thoracic vertebrae are represented mainly by neural spines that probably entered the site as partially filleted hump meat portions, and one of them was cut-marked during defleshing. Lumbar vertebrae are represented only by transverse spines, one of them cut-marked, that could have been introduced in tenderloins prepared for transport at the kill site. Cut marks on the medial surface of a scapula could result either from dismemberment or from filleting, and cuts on the medial surface of a mandible are probably associated with removal of the tongue. Impact scars are seen on the mandible, scapula, and all the major limb elements, and many fragments that were separated by fresh-state fracturing can be conjoined with one another. In all cases the conjoined fragments are from the same or adjacent excavation units, indicating that there was little

Table 23.6. Bison elements and fragments from Layer XIX.

Element	NISP	MNE	Calf	Cow or Calf	Cow	Bull
Occipital condyle	1	1	-	-	-	-
Jugal	1	1	-	-	-	-
Maxilla[a]	3	3	-	-	-	-
Mandible[b]	3	2	-	-	-	1
Cervical	4	3	-	-	-	-
Thoracic	9	5	-	-	-	-
Lumbar	5	3	-	-	-	-
Rib	4	4	-	-	-	-
Scapula	12	5	-	1	-	-
Humerus	5	2	-	1	-	-
Radius	14	5	1	4	-	-
Ulna	9	4	-	-	-	-
Carpal 4	1	1	-	-	-	1
Metacarpal III+IV	1	1	-	-	-	-
Innominate	6	4	-	-	-	-
Femur	11	4	1	-	-	-
Tibia	9	4	-	1	-	1?
Lateral malleolus	2	2	-	1	-	1
Calcaneus	1	1	-	-	-	1
Tarsal C+4	1	1	-	-	-	1
Tarsal 2+3	1	1	-	-	-	1
Metatarsal III+IV	1	1	-	-	-	1
1st phalanx	1	1	-	-	-	-
3rd phalanx	1	1	-	-	-	-
Med-prox sesamoid	1	1	-	-	-	-

a. 1 maxilla in age group C?, 1 in age group 4?, 1 in age group 5?. b. 1 mandible in age group 10-11.

scattering of the pieces after the fracturing events. The majority of recovered podials can be rearticulated to form a single chopping tool.

That carnivores had access to these bones is shown by tooth marks on ten of them. In all cases, the tooth marks are located in blood-rich, thin-walled areas of the bone and are well separated from both impact marks and cut marks. Only six specimens are weathered to Stage 1, but nearly all the bones are superficially etched by rootlets.

Size 5-6 mammal, unidentified, n=183: one cranial, 72 rib, 17 scapula, 93 long bone shaft fragments. The variety and frequency of bone alterations generally mirror the picture described for the bison bones (Table 23.7).

Wolf, Dog or Coyote, NISP=2: distal humerus, acetabulum with ischium. The humerus is too

Table 23.7. Modified vertebrate remains from Layer XIX.[a]

Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Fracture States					Total
							Teeth	Recent	Dry	Fresh	Whole	
6, Bison	5	5	10	-	6	100	2	-	17	81	7	107
5-6, mammal	5	8	8	-	*	*	-	11	11	161	-	183
4-5, large canid	-	-	1	-	-	1	-	-	-	2	-	2
4-5, mammal	-	-	-	-	1	-	-	-	1	-	-	1
3, Marten or Fisher	-	-	-	-	-	-	1	-	-	-	-	1
3, Rabbit or Hare	-	-	-	-	-	1	-	-	-	1	-	1
3, Snowshoe Hare	-	-	-	-	-	1	-	-	-	-	1	1
3, mammal	-	-	-	-	-	9	-	-	-	9	-	9
1, Deer Mouse?	-	-	-	-	-	2	-	-	-	1	1	2
-, mammal	4	555	5	13	*	*	-	*	*	*	-	2,625
Common Raven	-	-	-	-	-	2	-	-	-	2	-	2
Veery	-	-	-	-	-	1	-	-	-	-	1	1
Horned Lark	-	-	-	-	-	1	-	-	-	-	1	1
Bird	-	-	-	-	-	2	-	-	-	2	-	2

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

poorly preserved for reliable measurements as it has been furrowed by a carnivore. The innominate represents either a very large dog or a small wolf.

Size 4-5 mammal, unidentified, n=1: rib. This bone may also represent a large canid.

Marten or Fisher, NISP=1: C_1.

Rabbit or Hare, NISP=1: metatarsal II.

Snowshoe Hare, NISP=1: mandible containing I_1-M_3.

Size 3 mammal, unidentified, n=9: nine long bone shaft fragments. All of these are of appropriate size to represent rabbits or hares.

Deer Mouse?, NISP=2: proximal ulna, femur lacking its distal epiphysis.

Unidentified mammal, n= 2625: fragments of which all but 75 (4-10 cm) are less than 4 cm long. The four gaming pieces are the only cut bones among these fragments. Burned bones are abundant with 453 charred and 102 calcined pieces, most of which were located in hearth F19-a. All of the 13 digested bones occurred in XU 6 and could represent the contents of a scat.

Common Raven, NISP=2: distal ulna, distal carpometacarpus. Although not found locally today, ravens were formerly widespread on the Great Plains (see Layer XI, Chapter 15).

Veery, NISP=1: ulna. Veerys are fairly common summer residents in the aspen parkland, but they winter in central and South America (Godfrey 1966). Judging from records in southern Alberta (Salt and Wilk 1966:338), veerys probably arrive in south-central Saskatchewan in May and depart in September. This suggests that Layer XIX represents a summer season occupation.

Horned Lark, NISP=1: carpometacarpus. This is a common breeding bird of the prairie and parkland, and it also winters in southern Saskatchewan (Godfrey 1966:263).

Bird, unidentified, n=2: long bone fragments from a bird smaller than the raven.

Snails: Several small gastropods were recovered from XUs 4 and 6.

Discussion. Portions of bison representing at least four age/gender groupings are among only 107 identified bones. This indicates selective retrieval of body parts as well as the presence of a larger bone scatter beyond the limits of the excavation. The fragmentation pattern shows that some portions were prepared by butchering at the kill site while others were processed further at the Sjovold hearths. Primary butchering appears to have been designed to reduce the amount of bone transported to the Sjovold site, and secondary processing seems to have been oriented toward marrow retrieval and roasting of meat. The significance of the smaller mammals is not clear. They were not found in hearth fill, although they were located near the hearths. The two leporid bones as well as the unidentified size 3 mammal bones may represent a snowshoe hare that served as a dietary supplement. Mustelid skins with the skulls in place were used as clothing ornaments and in medicine bundles (Wright 1987), and the canine tooth could have become dislodged from such a specimen. In a similar vein, all the identifiable bird bones are from feather-bearing portions of wings that may have been valued as ornamentation on clothing or other artifacts.

Interpretation of Layer XIX

The focus of activities in Layer XIX was a group of features, together some 2.5 m in diameter, centered between XUs 4 and 5. Two important components of the grouping were hearths, one about 0.5 m north of the modern creek bank and the other about 1.75 m north of that. Both hearths were topped with thick layers of ash indicative of undisturbed burning of substantial amounts of fuel in a late phase of use. Ash covered the whole hearth in the southern example, but was thickest on a southern lobe of the northern hearth. These toppings of ash may have resulted from burning bison dung in order to dry some of the meat brought into camp. There was also a hide smoking pit near the margin of each hearth, in one case lying entirely within the boundaries of the hearth. These pits were used to colour and waterproof hides destined for such uses as clothing, tent coverings and moccasins.

Associated with each hide smoking pit was a single post mold, presumably the seat for a tall inclined stake from which a hide was suspended over the pit. The mouths of both smoking pits were collared with sterile soil and lay slightly above the levels of the adjoining hearths. We interpret this as an indication that the hide smoking occurred after the main functions of the hearths had been served, but, from other indications, before the occupational episode ended.

Hearth F19-a, farthest from the creek, contained a substantial amount of fired rock along with some fragmented bone, chipping debris and, around the margins, a few discarded tools. It also contained small pieces of baked clay which we suspect were removed and dropped in the fire from a digging tool used in excavating the hide smoking pits. The margins of the southern hearth contained similar materials (excluding baked clay), but in much smaller quantities. In the space between the two hearths was a dense jumble of fired rock, broken bones, soil mixed with charcoal and ash, a little chipping debris, and a few more discarded tools including four bone gaming pieces. This seems to have been an area where materials from the northern hearth, particularly fired rocks, were dragged, possibly to facilitate retrieval of hot rocks for stone boiling and to group some rocks into a hot platform upon which bones could be roasted and broken for marrow. Some of the debris between hearths, particularly bone, chipped stone and discarded tools, could also have been tossed or dumped there by people in areas adjoining to the east and west.

On the eastern fringes of the feature complex lay a continuation of rock and bone debris which appeared to be thinning out. On the northeast fringe of the complex were a few larger pieces of rock and bone, a clustering of chipping debris, and a couple of discarded projectile points within an area about a meter square. This may have been part of the seating area for a person who was feeding himself and repairing stone tools. Since associated tools were projectile points the person may have been a male. On the northwestern fringe there was a somewhat similar pattern of debris with a cluster of larger rocks and bones at a little distance from the hearth, and a projectile point in the edge of the hearth. That may have been part of another male seating area.

The area on the southwest fringe of the complex, extending almost two meters west, contained three clusters of debris. Nearest the hearth was a fairly dense cluster of chipping debris, a large scraper and some smaller pieces of fired rock. Fifty cm farther west was a cluster of large bone fragments. Forty cm west of that was another cluster containing a mixture of larger pieces of fired rock, chipping debris and a few pieces of bone. This three-part area may have been a woman's fireside cooking and working zone, with meat processing at the center, stone chipping at fireside and stone boiling and more stone chipping at the far (west) side. Beyond that, still farther west, were a few more bones, among them a metapodial bone flesher or chopper, and a considerable area of bare surface. That may have been a hide fleshing area.

We suspect that the group of features and adjoining activity areas were an out-of-doors arrangement. For one thing, smoke from two hide-smoking pits would have made a confined space uninhabitable. Thus, among Plains Indians hide-smoking tended to be an outdoor activity except during the worst parts of winter. Since the season of this occupation was summer, it seems unlikely that hide smoking pits would have been situated indoors. Furthermore, one suspects that if the hide smoking had been carried out within a dwelling, or even within a sun or wind shelter, then the structure of that shelter would have been used as a means for suspending hides over smoking pits. Since separate stakes were required for hide suspension, it seems likely that the smoking was done in the open where no other suspension structure was available. A final point supporting the notion that these activities were carried out in open air concerns the close proximity of the two hearths. It seems unlikely that two separate hearths would have been operated so close together within a shelter or even at its mouth. Rather, it is our suspicion that this complex of features formed the core of an outdoor kitchen.

Parts of bison representing at least four age/gender groupings were brought to the site for processing, and consumption. Their bones comprise the majority of the bone debris. From the representation of skeletal parts, it appears that primary butchering took place at a kill site, elsewhere, and that only certain cuts such as limbs, humps, tenderloins, the odd neck and skull part, and hides were brought back to this camp. The presence of a very young bison indicates that the season of occupation was summer. Traces of other kinds of animals — large canid, Marten or Fisher, Rabbit or Hare, Snowshoe Hare, Deer Mouse, Common Raven, Veery and Horned Lark — are also present, but whether they served as dietary supplements, parts of fur and feather clothing or ornaments, or some other purpose is not clear.

The duration of occupation extended over several days, perhaps lasting a week or more. The variety of activities which took place in connection with this occupation — hunting, butchering, consuming, and preserving of meat and hides from six bison — would have taken more than one day to complete. We also infer that the occupants felt sufficiently secure to scour the surrounding area for game other than bison. The mix of people in Layer XIX must have included at least one adult male and one adult female in order to account for the bison hunting and hide processing, respectively, but probably there were more people than just two. One could easily attribute the amount of game consumed and processed to the needs and capabilities of an extended family and probably to a family which was entertaining and sharing work with members of a larger camp. The presence of gaming pieces, indicative of gambling, provides additional evidence for the presence of persons from beyond the family circle.

The occupants were familiar with local sources of stone chipping materials as shown by their heavy usage of petrified peat. However, they also made significant use of Knife River Flint, an exotic material from North Dakota, as evidenced by several discarded tools and a small amount of KRF chipping debris. The KRF usage here seems greater than might expected from occasional recycling of other people's losses. It leads us to suspect that Layer XIX occupants had access to the North Dakota quarries either through travel or trade. The archaeological identity of Layer XIX belongs to the Pelican Lake series. Its absolute age, based on a radiocarbon assessment, is in the range of 1750-1450 BC (cal 3700-3400 BP; Table 3.6) which is toward the beginning of the Pelican Lake time span.

Chapter 24

Layer XX: A Pelican Lake Bivouac

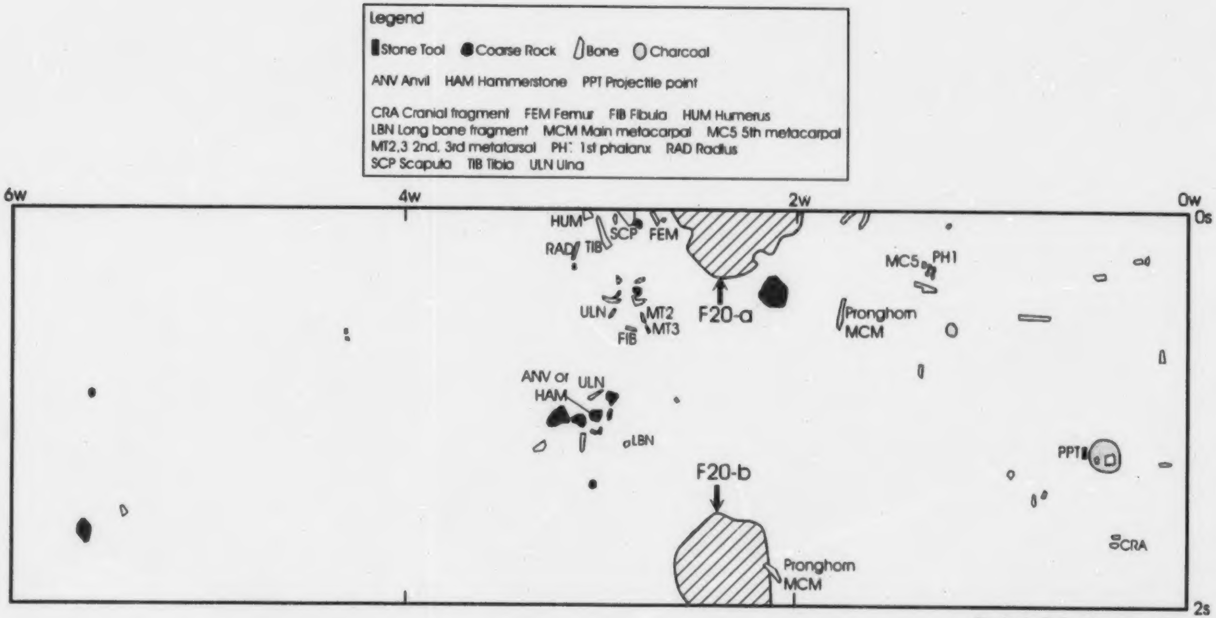
Introduction and Planview

Layer XX, a sparse Pelican Lake occupation dating between 1950 and 1650 BC (cal 3900-3600 BP; Table 3.6), lies 365-373 cm BS at 0n2w. Cultural debris was our principal guide to location. Two small hearths and sparse amounts of bone, coarse rock, chipped stone debris and stone tools were exposed in an 11 m^2 area. Where debris was absent the occupation level was difficult to find. It appears that the high point on the surface was about 364 cm BS at 0n0.75w. From that point the surface sloped gently downward (7:350) to the west and south. Layer XX was trowelled and screened in two levels, and all recovered materials are reported here. We shovel-shaved the underlying deposits, about 29 cm in thickness, without screening, and found a few items of bone and stone which are reported under Interlayer XX/XXI. Part of a clay-filled animal den, which began in Layer XV, passed straight downward through Layer XX removing about 2000 cm^2 of the occupation surface on the south edge of XU 4. In addition, a large sloping sand-filled burrow at the northwest corner of XU 6 removed about 1300 cm^2 of the occupation surface but apparently did little damage to the archaeological record since cultural remains were absent in that vicinity.

The planview for Layer XX (Fig. 24.1) shows the locations of two features, two stone tools, an unidentified size 5-6 mammal cranial fragment, two pronghorn bones, and a scatter of labelled dog and/or coyote bones around F20-a.

Features

Feature 20-a (Figs. 24.1-24.2, Table 24.1) was a thin surface hearth, the southern half of which was exposed along the north edge of XU 5. It was composed of: an upper layer, 0.5-2.0 cm thick, of ash, charcoal, six fragments of fired rock weighing 13.3 g and a few pieces of burned bone; and a lower layer of burned soil, 1-2 cm thick, which was black at the top and rusty red at the bottom. The contact between hearth layers was at the same level as the surrounding occupation surface (as indicated by basal positions of artifacts near the hearth). A small cluster of broken bones was intermixed with a few pieces of rock about 5-30 cm west of F20-a. Another small cluster of bone and rock fragments, including a small stone chipping hammer or anvil, was situated about a meter southwest of the hearth. One half of a large andesite cobble lay with its cortical face down, flat fracture face up, about 10 cm southeast of F20-a. There was very little else nearby. To the east and southeast was an extensive but sparse scatter of broken bones extending to the limit of XU 4. Among


Legend
▮ Stone Tool ● Coarse Rock Bone ○ Charcoal
ANV Anvil HAM Hammerstone PPT Projectile point
CRA Cranial fragment FEM Femur FIB Fibula HUM Humerus
LBN Long bone fragment MCM Main metacarpal MC5 5th metacarpal
MT2,3 2nd, 3rd metatarsal PH1 1st phalanx RAD Radius
SCP Scapula TIB Tibia ULN Ulna
6w
4w
2w
0w
0s
2s
HUM
SCP
FEM
RAD
TIB
ULN
MT2
MT3
FIB
F20-a
Pronghorn MCM
MC5
PH1
ANV or HAM
ULN
LBN
F20-b
Pronghorn MCM
PPT
CRA

Planview by ID, Corel rendition by REM

Figure 24.1. Planview of Sjovold Layer XX.

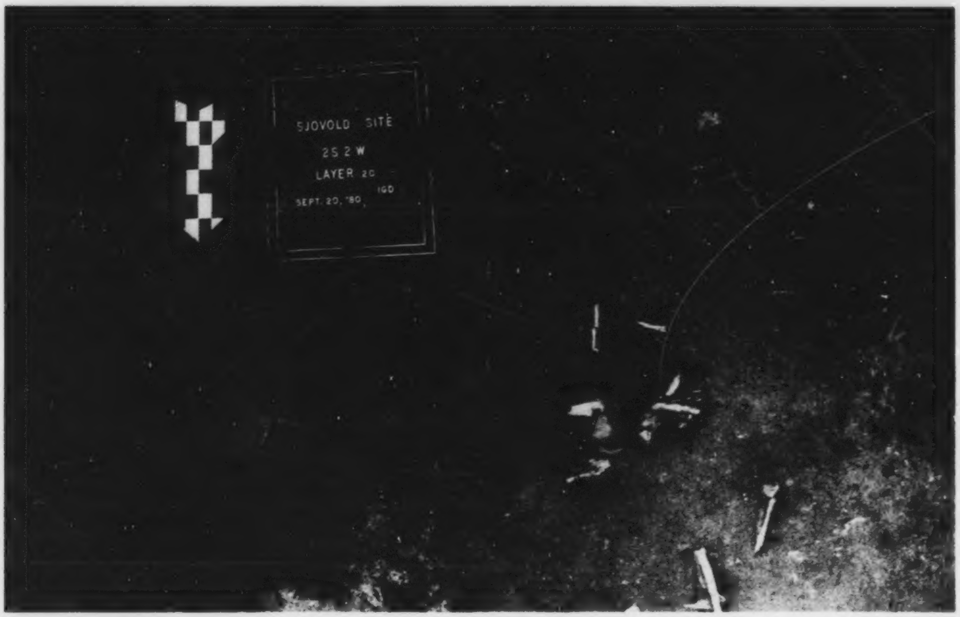


Figure 24.2. Hearth F20-a and nearby canid and pronghorn bones. RSM #EiNs-4:80-317 CT.

Table 24.1. Features in Layer XX.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F20-a	surface hearth	5s232w	>34	60	3
F20-b	surface hearth	187s235w	>45	45	<2

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

this material, about 1.5 m southeast of F20-a, was a tiny stemmed projectile point. The only other clustered remains were those of F20-b about 1.25 m due south of F20-a.

The fact that F20-a consisted of both surface ash and underlying burnt soil indicates that it was a hearth and not simply a spot where hearth debris was dragged or dumped. Having a small diameter (ca. 60 cm) and an unusually thin combination of ash and burned subsoil (about 3 cm), F20-a was apparently the remains of a modest, short-lived fire. Our guess is that most of the fuel was a mixture of bison dung and wood. This is based on the high proportion of ash to charcoal, the fact that most charcoal was in the form of small powdery smears, and the shallowness of the subsurface burn — all indicative of bison dung fuel. A few chunks and twig-like pieces of charcoal were found on the fringes of the hearth, hence the possiblity that a portion of the fuel was wood. The presence of small pieces of fired rock within the hearth shows that rock heating was one of its functions. Bone roasting may have been more important, followed by bone breaking and marrow consumption a short distance to the west and southwest. The absence of chipped stone debris and tools leads to the inference that stone tool manufacture and repair, common fireside activities, were not undertaken at this particular hearth.

Feature 20-b, apparently a second hearth, was situated on the south edge of XU 5 some 1.25 m south of F20-a. The northwestern three quarters of this feature was exposed. It consisted of three layers: (1) uppermost, a 2 cm deep mixture of soil and powdery pieces of charcoal up to 1.5 cm in diameter; (2) in the middle, ash, slightly less than 1 cm in thickness and less extensive than the overlying layer; and (3) on the bottom, 0.5 cm of blackened earth. In addition there were two holes filled with combustion residues beneath the feature. Under the center, apparently originating in the ash level, was a downward curving hole, 2-3 cm in diameter through most of its 8-10 cm length, which was full of ash mixed with small pieces of charcoal. Under the southwest fringe was a westward sloping hole, originating at the ash level, with a mouth about 2 cm in diameter but which gradually tapered to about 0.5 cm at the far end some 6-8 cm below the feature. This second hole was filled with jet black carbonized material. There was no fired rock in or near F20-b. In fact the only cultural materials in the immediate vicinity were a couple of bone fragments on the eastern margin.

It is difficult to understand this feature for several reasons: its unusual upper layer, its incomplete exposure, and its very sparse contextual information. Our tentative interpretation is that the ash and underlying burned earth represent a small and very short-lived hearth possibly used to singe or to lightly roast something. Whether the covering earth and charcoal served in the use of the hearth (burying something being roasted) or only to extinguish the fire is not clear. The hole beneath the center of the feature is also puzzling. If it had been a stake mold for a pole from which something was suspended over the fire we would expect it to have been straight up and down, not curved. Had it been a root burned in place we would expect an all-ash fill or, more likely, all charcoal, but not a mixture. It may have been part of a small rodent burrow which became filled with ash and charcoal from the hearth. The second hole, filled with carbonized material on the southwest fringe, was probably a root burned in place beneath the hearth.

There are other cases known in which a small hunting group built a special purpose hearth close to a central campfire. One example occurred at the Anaktiqtauk site, Alaska, where three caribou hunters used a main hearth to warm themselves and to roast marrow bones. They also made a second quick-flaming hearth about 1.5 m away to boil water for a broth (Binford 1983:154). We suspect that a similar situation is reflected in the two hearths of Layer XX. Although we cannot be certain about the specific function served by F20-b we suspect that it was supplementary to the roasting and warming activities focused around hearth F20-a only a short distance to the north.

Table 24.2. Coarse rock from Layer XX.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
andesite	-	3	-	3	-	1701	-	1,701
diabase	1	-	-	1	1	-	-	1
gneiss	-	7	1	8	-	511	39	550
granite	-	3	-	3	-	2	-	2
grano-gneiss	-	-	1	1	-	-	477	477
unidentified	-	1	-	1	-	4	-	1
Total	1	14	2	17	1	2,218	516	2,735

Table 24.3. Stone tools from Layer XX.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
anvil or hammer	7834	5	58.7	53	41	17	andesite	y	24.3b
projectile point	7820	4	1.0	22	15	3	petrified wood	n	24.3a

Rock

The sample of coarse rock from Layer XX is a small one (Table 24.2). All of it showed evidence of firing except for the largest piece of andesite (situated a little south of F20-a) and several pieces which are too small to evaluate. The average weight of definitely fired materials was 133.58 g, indicating a low level of disaggregation and a modest amount of use consistent with the presence of short-lived hearths in this layer.

Stone Tools

Anvil or hammer (n=1). Catno 7834 is a small flat khaki-grey cobble, a natural decortication spall with naturally rounded edges (Fig. 24.3, Table 24.3). Toward one edge of the curved dorsal face are a series of at least eight shallow parallel incisions, less than 1 mm in width and depth and ranging from 4-15 mm in length. They occupy a little less than 2 cm^2 of the surface. No other modifications are evident. It appears that the incisions were due to a series of impacts with a thin straight tough edge. Catno 7834 could have been used either as a small hammerstone or as an anvil.

Projectile point (n= 1). Catno 7820, found toward the southwest corner of XU 4, is a tiny stemmed point missing only a small part of its tip (see Fig. 24.3). The sides of the blade are straight; the notches are broad and deep; the barbs on the shoulders are right-angled and sharp; the base,

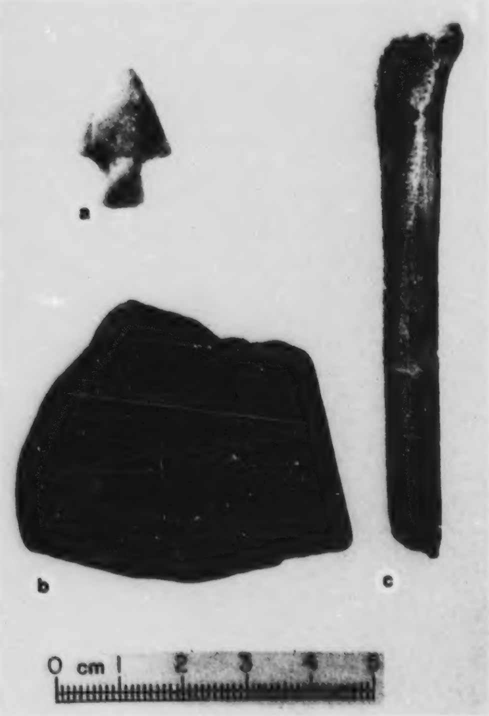


Figure 24.3. Projectile point (a), anvil or hammer (b), and pronghorn bone (c) from Layer XX.

substantially narrower than the shoulders, is essentially straight and sharp. All edges have been bifacially chipped, exhibiting considerable skill by the maker in coping with pervasive interlaminar faults and the step-like fractures they caused. Because material faults undoubtedly influenced the final shape of this artifact only general comparisons are warranted. Perhaps 1-2 mm of the tip has been removed by an impact fracture. There is a creamy white residue, probably calcium carbonate, in crevices on one face. On the other face there are yellow-cream residues with rusty red spots in a deep crevice on one side of the haft. This may be blood residue. The tip and part of an adjoining edge are a red-mauve colour, presumably due to exposure to fire.

In general, this point is similar in shape and size to the smallest Pelican Lake specimens found at the Mortlach site (Wettlaufer 1955:Pl.11, Nos.4-6). Application of the Thomas (1978) discriminant classification equations indicates that the point probably served as an arrowhead.

Chipped Stone Debris

The only three pieces of chipping debris in Layer XX were two small chips of Knife River Flint (0.1 g) and one cortical spall of andesite (0.9 g). All three were found in a cluster, about 15 cm across, near the southeast corner of XU 4. The projectile point, catno 7820, was also part of that cluster. One of the KRF chips contains a very small segment of a unifacially retouched edge. The other is a bifacial thinning flake. Both are slightly clouded and have adhering black particles indicating contact with fire. There was one small chunk of powdery charcoal amidst the cluster and another about 10 cm southwest, but no other hearth residues in the immediate vicinity. There were, however, several fragments of bone at the same level in the surrounding area. It crossed our minds that this small cluster of debris might somehow be intrusive from Layer XIX. However, there were other cultural materials at the same level nearby, including a piece of charcoal, and no signs of disturbance, except for the large animal burrow 25 cm to the south which did not affect these artifacts. Moreover, the hearths in Layer XIX were not directly above the flake cluster in Layer XX. The coincidence in stone types in the two layers could be explained as a cultural similarity, although it is a pity that the question of provenience cannot be resolved beyond doubt. For the time being it seems to us that the case for contemporaneity with Layer XX is better than that for intrusion from Layer XIX, and we interpret the chipped stone materials accordingly.

Bone Tools

A pronghorn metacarpal segment from XU 5 (catno 7840) has been shaped by the groove-and-splinter technique (see Fig. 24.3c). The piece has been removed from the posterior-medial corner of the proximal end of a pronghorn right metatarsal. It is 82.3 mm long and 19.1 mm wide near the middle. A longitudinal groove was cut into the floor of the natural groove on the posterior face of the metacarpal, and the cut appears to have guided the splintering of the bone. No corresponding cut is seen on the medial face, but the fracture surface has been straightened and smoothed by scraping. The distal end is formed by a fresh-state fracture that may represent accidental breakage during the preparation of a tool blank. We cannot infer a function for this specimen, but it may have been a preform for a bone tool.

Faunal Remains

Portions of a bison scapula, weighing 307 g, from XU 5, comprised a radiocarbon sample (S-2061) for Layer XX, and the remaining bone is shown in Table 24.4.

Size 5-6 mammal, unidentified, n=18: two cranial, 16 long bone shaft fragments. One long bone fragment from XU 5 bears a cut mark.

Pronghorn, NISP=2: metacarpal shaft, proximal metacarpal. The proximal fragment has been interpreted as a tool blank.

Dog and/or Coyote, NISP=18: scapula blade, two distal humeri, proximal radius*, ulnar semilunar notch*, ulna shaft, accessory carpal, proximal metacarpal V*, femur shaft, two tibia shafts, two fibula shafts, metatarsal II*, proximal metatarsal III*, distal metapodial, 1st phalanx, 2nd phalanx. The five elements marked with asterisks (*) furnished interesting measurements. The three forelimb elements fall well within the ranges of our reference dogs with respect to both size and allometry. However, the two metatarsals are much too slender to represent dogs, and they are very similar to coyotes. Perhaps there was a breed of dog with robust front quarters and gracile hind quarters. Cut marks are seen on the right humerus, the femur, and the distal end of metatarsal II. The latter may have been inflicted during removal of the skin, and the other two appear to be defleshing marks. The

Table 24.4. Vertebrate remains from Layer XX.

	Number				Weight			
Size, Taxon	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
5-6, mammal	4	14	-	18	17.9	41.1	0.0	59.0
5, Pronghorn	1	1	-	2	20.0	4.2	-	24.2
4, Dog and/or Coyote	2	16	-	18	3.1	89.6	-	92.7
-, mammal	25	83	3	111	21.9	35.2	6.2	63.3
Total	32	114	3	149	62.9	170.1	6.2	239.2

Table 24.5. Modified vertebrate remains from Layer XX.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
5-6, mammal	1	-	-	-	*	*	-	-	2	16	-	18
5, Pronghorn	1	-	-	-	-	2	-	-	-	2	-	2
4, Dog/Coyote	3	4	-	-	-	15	-	-	6	9	3	18
-, mammal	-	25	-	-	*	*	-	*	*	*	-	111

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

scapula, accessory carpal, metacarpal V, and 1st phalanx are charred, and the carpal was found in hearth F20-a.

Coprolite, n=1: a small fragment of a mammal scat, measuring 23 X 17 X 9 mm, was found just west of hearth F20-a. It consists of masticated osseous spongy tissue embedded in light gray fecal matter, and it is probably a fragment of canid scat.

Unidentified mammal, n=111: fragments less than 4 cm in length except for five longer (4-12 cm) ones. Burned specimens (5 charred, 20 calcined) are associated mainly with hearth F20-a.

Discussion. This small assemblage reveals a variety of subsistence activities including roasting and filleting of meat, and cracking of marrow bones. It is not clear whether the pronghorn was part of the diet, since only two bones were recovered, but it supplied raw material for tool manufacture. This is the only layer in the Sjovold site where we are confident that a canid was of dietary importance. The pattern of bone alterations (butchering, fresh-fracturing and charring) and the association with a hearth feature support this interpretation.

Interpretation of Layer XX

Occupation of Layer XX lasted only a day or two and involved very few people, perhaps only a couple of hunters. Activities were focused around hearth F20-a and involved roasting a few large mammal bones and breaking them for marrow consumption; dismembering and roasting dog and/or coyote portions; heating a few rocks, presumably for stone boiling; and using a few pieces of andesite rock as anvils or hammerstones. During the occupation broken bones and rocks were dropped or tossed to the west, southwest and southeast of the F20-a. A damaged projectile point and a couple of retouching flakes from two other tools were discarded about 1.5 m southeast of F20-a. A small supplementary hearth was built about 1.25 m south of F20-a and may have been used to singe or roast some object. The occupants belonged to the Pelican Lake archaeological series. The age of occupation was between 1950 and 1650 BC (cal 3900-3600 BP; Table 3.6), based on a radiocarbon date for the layer and bracketing dates for layers immediately above and below. This is among the oldest of Pelican Lake dates.

Interlayer XX/XXI

Coarse Rock (Table 24.6): Most of the rock was from the deepest parts of the interlayer immediately above Layer XXI. A few pieces were also found at intermediate levels. Except for one nodule of chert, one small piece of limestone and several crumbs too small to evaluate, all the rock had been fired, probably in hearth F21-a.

Chipped Stone Debris: A single decortication spall (catno 7872) of dark blue/green amphibolite was found in XU 4. It weighs 6.2 g. The spall has a small crushed area on its proximal end where a concentrated force has caused its detachment. In this respect, as well as in shape and size, it looks much like a normal decortication flake resulting from stone chipping for tool manufacture. However, the material is too coarse for manufacture of a small tool. It could be that the chipper thought he was opening an andesite cobble and stopped work upon discovering his mistake. On the other hand, though it seems less likely, the spall could be due to natural rather than human breakage.

Faunal Remains:

Bison, NISP=3 (83.9 g): scapula blade, tibia shaft, hind 2nd phalanx. The scapula and tibia were fractured when fresh, and the edge of the scapula blade was gnawed by a carnivore.

Size 5-6 mammal, unidentified, n=14 (60.5 g): one cranial, nine rib, four long bone shaft fragments. Twelve were fractured when fresh.

Unidentified mammal, n=255 (199.6 g): fragments of which only seven (4-8 cm) are longer than 4 cm. Most of the eight charred and 29 calcined fragments are from XU 4. In the same unit, one

Table 24.6. Coarse rock from Interlayer XX/XXI.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
chert	-	-	1	1	-	-	55	55
concretion	1	-	-	1	1	-	-	1
gneiss	2	-	-	2	9	-	-	9
granite	12	2	-	14	603	5	-	608
limestone	1	-	-	1	3	-	-	3
quartzite	1	-	-	1	13	-	-	13
sandstone	3	2	-	5	11	19	-	30
Total	20	4	1	25	640	24	55	719

is tooth-marked, and four are digested.

Sucker, NISP=1 (<0.1 g): vertebra fragment, from XU 4.

Yellow Perch, NISP=1 (<0.1 g): scale, from XU 4.

Fish, unidentified, n=52 (0.4 g): unclassifiable fragments, from XU 4.

Snails, n=12: small gastropods recovered from XU 4.

Interpretation of Interlayer XX/XXI: Most of the material in the interlayer was derived from the top of Layer XXI. The concentration of fish remains and small snails could represent a single pellet from a bird such as a heron.

Chapter 25

Layer XXI: At the Edge of a Hanna Camp

Introduction and Planview

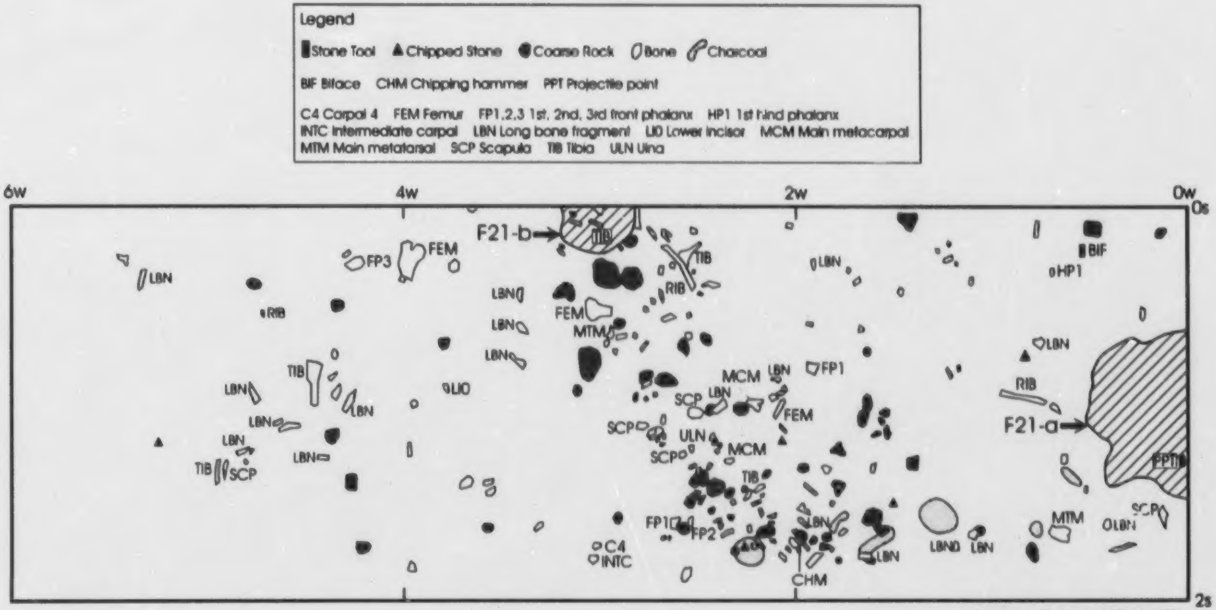
Layer XXI, a Hanna occupation dating to approximately 2050-1650 BC (cal 4000-3700 BP; Table 3.6), lies 402-413 cm BS at 0n2w. There were two hearths, a fair amount of coarse rock and broken bone, a small sample of chipped stone debris, and three stone tools found in XUs 4-6 (plus an additional stone tool in an adjoining test profile). Occupation remains were covered by buff-brown clay and rested on an undulating bed of olive-brown clay (Sedimentary Bed 14). Undulations with amplitudes of 4-8 cm and widths of 25 to 50 cm ran in waves across the occupation surface and roughly parallel to the creek bank. In addition, a shallow depression in XU 5, containing hearth F21-b and considerable cultural debris, ran northwest to southeast across the general axis of undulations. Another complication was an east to west slope from a high point (400 cm BS) at 0n0w to a low point (430 cm BS) at 0n3w, but beyond 0n3w the occupation was roughly horizontal to 0n6w. Thus, Layer XXI artifacts, with differences in elevation of as much as 20 cm, were actually on the same undulating occupation surface.

The large animal den on the south edge of XU 4 first encountered in Layer XV continued through Layer XXI but seemed to be narrowing. It removed a strip of occupation surface amounting to about 800-1000 cm^2 from the south-central edge of XU 4. The sloping animal burrow (infilled with sand) seen previously in XU 6 continued downward through Layer XXI where it removed about a 1200 cm^2 strip of the surface along the north-central edge of the unit. We trowelled and screened Layer XXI in two levels, terminating excavations at its base, except for an 18 cm deep section pit through F21-b where cultural materials disappeared below the deepest part of the feature.

The Layer XXI planview (Fig. 25.1) shows the locations of both features, several patches of charcoal, a chipped stone biface, a chipping hammer, a projectile point, and a scatter of bison and unidentified size 5-6 mammal bones.

Features

Feature 21-a (Figs. 25.1-25.2, Table 25.1) was about one-half exposed on the east edge of XU 4. It was a 2 cm thick semi-circular surface clustering of powdery charcoal chunks, ash, ash-infused and charcoal-infused soil, some finely broken calcined bone fragments, six small chipped stone flakes, a palm-size patch of red ochre on the southwest corner, and a large disintegrated bone fragment plus a chipped stone projectile point on the south edge. There was no stained or burned earth beneath this


Legend
▮ Stone Tool ▲ Chipped Stone ● Coarse Rock Bone Charcoal
BIF Biface CHM Chipping hammer PPT Projectile point
C4 Carpal 4 FEM Femur FP1,2,3 1st, 2nd, 3rd front phalanx HP1 1st hind phalanx
INTC Intermediate carpal LBN Long bone fragment LIO Lower incisor MCM Main metacarpal
MTM Main metatarsal SCP Scapula TIB Tibia ULN Ulna
6W
4W
2W
0W
0S
2S
F21-b
F21-a
FEM
FP3
LBN
RIB
TIB
SCP
LIO
MTM
MCM
FP1
ULN
FP2
C4
INTC
CHM
HP1
BIF
PPT

Planview by ID. Corel rendition by REM

Figure 25.1. Planview of Sjovold Layer XXI.

Table 25.1. Features in Layer XXI.

FeaNo	Type	CenterPt[a]	Length[b]	Width	Thickness
F21-a	hearth or hearth debris	105s13w	85	>52	2
F21-b	hearth or hearth debris	0s300w	>23	35	2

a. measured in cm from southeast corner of excavation unit 0n0w (XU 1); b. maximum length (north-south), width (east-west) and thickness measured in cm.

thin layer of hearth debris. Around the western margin of F21-a to a distance of about 75 cm was a sparse scatter of bone fragments, a few pieces of fired rock, the odd piece of stone chipping debris, a few pieces and small clusters of charcoal, plus a broken chipped stone biface. Beginning about 125 cm west southwest was a denser scatter of similar debris about a meter in width and oriented southeast to northwest. Hearth F21-b lay at the northwest end of that scatter and both the scattered debris and F21-b lay within a shallow trough in the occupation surface.

The combination of elements present in F21-a could be interpreted either as the seat of a hearth or as a place where hearth materials were dumped or dragged. Evidence for the hearth interpretation includes the size and shape which are on the small side but within the range for hearths in other layers. In addition, the sparse scatter of debris around F21-a, including a couple of stone tools, is similar to the pattern seen around some other hearths in the site. On the other hand, the total absence of an underlying lens of stained and burned earth distinguishes F21-a from all other hearths in the site. Even the unusual hearths of Layer XIV overlay thin lenses of burned subsoil. About the only kind of hearth we can imagine that would leave no trace of subsurface roasting would be a hearth built on an intermediate substance such as packed snow or damp organic matter, which disintegrated during or after the life of the fire thereby allowing hearth residues to subside onto the ground. Since our sole seasonal indicator (bison teeth) hints at summer or fall occupation, snow as an intermediate bed for the hearth seems unlikely. Another circumstance which is not very supportive of the hearth interpretation is the undulating soil surface. Although the small area on which F21-a was situated was relatively flat, the surrounding area was definitely wavy. One imagines that such a locale could be used for a hearth, but it would not be as good as smoother surfaces if such existed nearby.

Some of the same evidence which causes us to doubt the hearth interpretation could be used as support for hearth drag or dump interpretations, especially the absence of subsoil burning. If hearth debris were simply dumped or dragged onto a location as a result of hearth maintenance elsewhere, the dump site might have many of the same characteristics as a hearth while lacking the underlying burned subsoil. Another line of observation concerns the apparently diverse array of individual bison represented by the rather small collection of bones recovered from our Layer XXI exposure (see below). Either the occupants were scavenging old bones from the general vicinity or the main focus of this occupation was not within our view. According to the second line of reasoning, F21-a could have been situated on the fringe of a main occupation area and could have been an area where debris

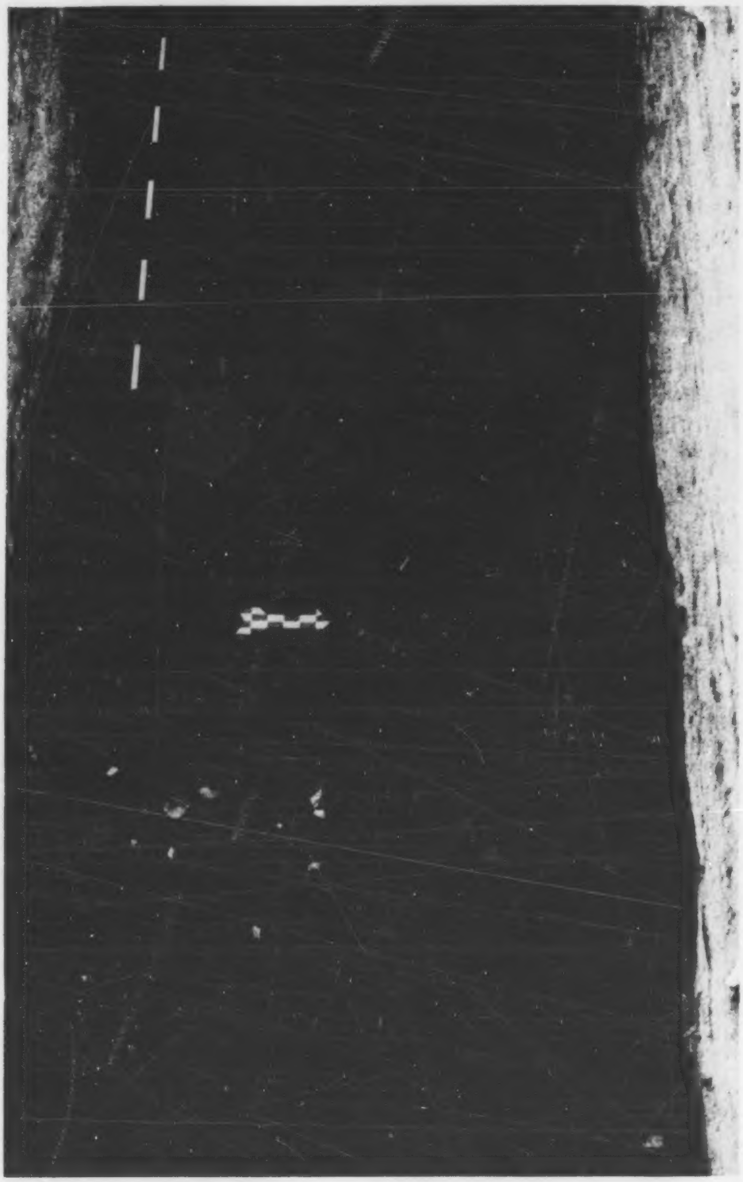


Figure 25.2. Hearth F21-b (right) and associated debris viewed from the east.
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was dumped. In the end we feel slightly more inclined toward the drag or dump interpretation than the hearth interpretation, but we feel that there is insufficient evidence to make a confident decision.

Feature F21-b, also only partly exposed, was similar to F21-a, but smaller. It was composed of a 1-2 cm thick layer of charcoal and ash and charcoal-infused soil, on and in which were sprinkled several small pieces of fired rock, one piece of stone chipping debris and a few fragments of bone, all within an area about 35 cm in diameter. There was no lens of stained or burned earth underlying F21-b, only the olive-brown silty clay of subsurface sediments. Adjoining to the east and southeast were two large bone fragments which had disintegrated to powder. This state of preservation is distinctly different from that of most other bone fragments in the layer and one wonders why some bones might be in an advanced state of disintegration while others remained in a well-preserved state. Richter's (1986) experiments with fish bones show that boiling is more destructive of bone collagen than roasting. Other studies cited by Richter show that denatured collagen is prone to further degradation by microorganisms such as soil fungi. Thus, the powdery bones in Layer XXI may have been subject to boiling while other bones may not. The close association of powdery bones with features F21-a and F21-b is also curious. One wonders whether charcoal and ash somehow retard bacterial or fungal degradation of bones so that powder, at least, survives. Perhaps even those traces would have disappeared had they not been in close association with charcoal and ash.

Between the powdery bones on the fringe of F21-b was a medium-size fragment of fired rock. These three items, as well as being in direct association with F21-b, were apparently also part of a large elongate scatter of debris including fired rock, broken bones, the odd piece of chipping debris, the odd piece or cluster of charcoal and one chipping hammer all of which extended more than 2 m to the southeast. A less dense scatter of bone and coarse rock was situated in the adjoining western area extending up to two meters southwest of F21-b.

We are faced with a similar interpretive dilemma for F21-b as we had for F21-a. Inconclusive arguments can be marshalled for quite different interpretations — an unusual kind of hearth, or a zone into which hearth debris was dragged or dumped. In this case the attachment of a dense elongate scatter of campsite debris makes us lean even more toward the dump interpretation, as one can readily imagine debris being dumped at F21-b and spilling down the trough to the southeast. However, we would still prefer additional evidence before drawing a conclusion.

Rock

A substantial sample of coarse rock was recovered (Table 25.2), more than 98% by weight having being fired. Only two pieces of limestone, two unidentified pieces, a piece of quartz porphyry, and nine small pieces of gneiss, sandstone and granite showed no evidence for firing or were ambiguous in that regard. The dominant material in this layer (by weight) was gneiss (46.2%), followed by grano-gneiss (24.8%), granite (10.9%), quartz porphyry (6.9%), quartzite (5.5%) and

Table 25.2. Coarse rock from Layer XXI.

		Number				Weight		
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
amphibolite	1	1	-	2	2	13	-	15
gneiss	25	19	5	49	1189	3227	953	5,369
granite	17	8	1	26	758	397	112	1,267
grano-gneiss	44	4	-	48	1537	1346	-	2,883
limestone	1	1	-	2	7	41	-	48
quartz porphyry	1	1	-	2	745	52	-	797
quartzite	7	3	-	10	596	47	-	643
sandstone	9	19	-	28	52	390	-	442
syenite	-	1	-	1	-	71	-	71
unidentified	2	2	-	4	14	71	-	85
Total	107	59	6	172	4,900	5,655	1,065	11,620

sandstone (3.8%). All other materials appeared as only a trace. This is one of several layers (III, IV/V, VII, VIII, XX and XXI) which were not dominated by granite, but as with most of the other exceptions, its dominant materials are part of the granite, gneiss and grano-gneiss group which rank 1-3 in surface deposits adjoining the site (Dyck 1990). The average weight of rock in this layer is 67.5 g which is in the moderate range for disaggregation and for use.

Stone Tools

Biface knife (n=1). Catno 7903, found about 50 cm northwest of F21-a, is one end of a biface knife (see Fig.25.3). Both faces are completely covered with flake scars, those resulting from final retouching of the edge being 4-10 cm in length. The edge is quite thin (less than 2 mm) and nearly straight in profile. In plan the edge is strongly curved from one side across the end to an offset point almost at the other side. There the edge turns abruptly, making a sharp point with an angle of approximately 95°, and continues almost straight down the other side. Under the microscope the retouched edges show light rounding and polish on high points. There are chalky white residues in deeper crevices, particularly on one face. Presumably these are calcium carbonate from the soil. There are also a few jet black particles, possibly charcoal, among grains of soil clinging to some crevices. These indicate association of the object with fire residues. The biface broke along a fracture roughly perpendicular to the sides and to the planes of the faces. The edge of this fracture is sharp where it joins one face, but rounded where it meets the other, indicating a snapping type of fracture. Thus, it appears that this well-made object was used lightly as a knife for cutting, and broke as a result of use in a prying action.

Biface preform (n=1). Catno 8057 was found within Layer XXI in Test Profile 4 about 1.2

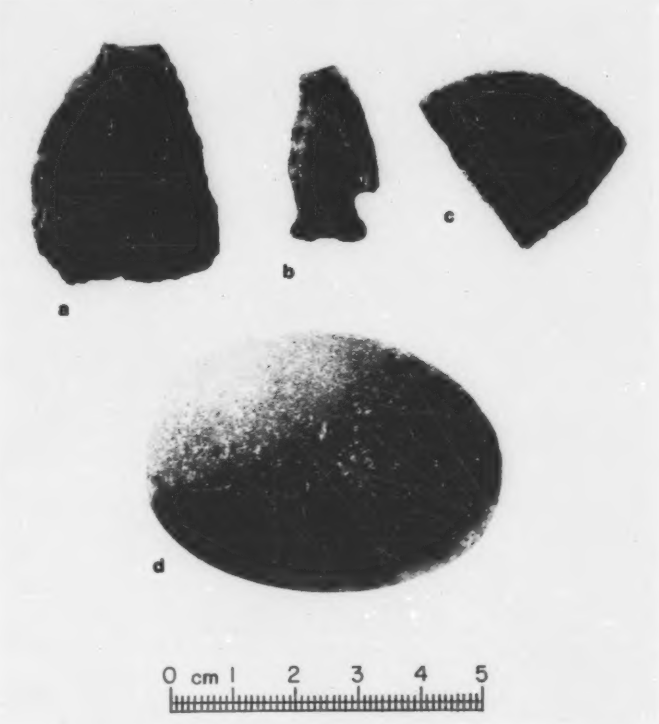

Figure 25.3. Biface preform (a), projectile point (b), biface knife (c), and chipping hammer (d) from Layer XXI.

m south of XU 5. In this position it appears to have been part of the elongated concentration of debris extending southeast from F21-b. The object has a roughly triangular outline and has flake scars covering most of both faces. One face bears a central ridge, parallel to and almost on its long axis. This ridge seems to have presented a problem which the flintknapper could not overcome. Long broad thinning flakes struck from one lateral edge left deep step fractures at the base of the ridge on one side, but did thin that edge. The knapper was unable to drive thinning flakes from the other edge. Though he tried in several places only one flake was more than 10 mm in length and it feathered out on the central ridge. Most of the rest of the edge showed only short flakes and crushing. Although the edge was slightly thinner as a result, it still remained over 6 mm thick. In one place no thinning had been attempted and a remnant of an early secondary flake scar was left perched high on the edge. A similar remnant of an early secondary flake scar, not so highly perched, was left untouched on the opposite face of the other (thinner) edge. This object probably represents an attempt at projectile point manufacture which failed at a fairly advanced stage upon encountering material faults which could not be overcome.

However, there is some evidence that the piece, although flawed, was touched up a little bit and used as a cutting tool. The longest thinnest segment of one side, a little more than 30 mm in length, shows considerable rounding and polish. A portion of the edge bears a line of dark brownish-red blood-like residue along the crest. There is also a mass of fibres seated in a buff-coloured residue in a crevice toward one end of that edge. Some of the fibres are black/blue and some are colourless or white/buff. This evidence seems to point to use in cutting a bloody fibrous substance. The two sides

Table 25.3. Stone tools from Layer XXI.

Type	CatNo	XU	Weight	Length	Width	Thickness	Material	Whole	Fig.
biface knife	7903	4	6.6	25	31	6	Knife River Flint	n	25.3c
biface preform	8057	*0	11.2	39	31	8	petrified peat	n	25.3a
chipping hammer	7895	4	107.9	56	41	27	quartzite	y	25.3d
projectile point	7900	4	2.6	29	16	5	Knife River Flint	n	25.3b

* This item came from Layer XXI in deep test profile No. 4 about 120 cm south of XU 5.

Table 25.4. Chipped stone debris from Layer XXI.

	Number				Weight			
Material	XU 4	XU 5	XU 6	Total	XU 4	XU 5	XU 6	Total
agate	1	-	-	1	0.1	-	-	0.1
Knife River Flint	7	-	-	7	2.0	-	-	2.0
petrified peat	-	-	1	1	-	-	7.7	7.7
quartzite	1	1	-	2	25.5	3.6	-	29.1
silicified sediment	1	1	-	2	1.3	1.6	-	2.9
Total	10	2	1	13	28.9	5.2	7.7	41.8

of the object converge toward what should have been a fairly acute-angled point, but the point itself is missing. It snapped off about 8 mm from the tip. This is reminiscent of the snapping fracture on catno 7903 and may indicate similar use. There are extensive chalky residues, presumably calcium carbonate, in crevices all over the ridged face of catno 8057. Soil adhering to crevices on the other face is intermixed with numerous particles of charcoal. These adhering materials are similar to those found on catno 7903 and the charcoal, in particular, indicates that the item, although not found in direct association with a hearth, had been in contact with fire residues.

Chipping hammer (n=1). Catno 7895 was found about 2 m southeast of F21-b in an elongate concentration of debris. It is a small oval quartzite pebble with extensive cortical crushing and pitting at both ends and minor additional pitting on adjoining parts of the sides. Pitting and crushing to a depth of about 1 mm covers an area about 11 by 16 mm on each end. On the sides pitting and crushing is not continuous, but occurs as individuals points of impact, lines of points, and short grooves. These diminish rapidly and are more or less absent one cm from the ends except for a few points of impact clustered about the middle of one side. There is a sparse microgranular rusty red residue in the crevices of one crushed area and in many of the pits, both crushed and natural, on the adjoining side. In some places rusty red residue is intermixed with or overridden by a scab-like residue of dark brownish-black material. The combined red and black residues have the appearance of blood. The opposite end and much of one side bears a fairly extensive coating of a chalky white substance. Our guess is that catno 7895 was used for stone chipping and held in a bloody hand. It seems a bit light for bone breaking, but that is an alternative interpretation which might also fit with the pitting and presence of blood-like residues.

Projectile point (n=1). Catno 7900, a broken point (see Fig. 25.3), was found on the south side of F21-a. Both faces appear to have been entirely covered by flake scars due to thinning and shaping. The most complete lateral edge is gently convex. The opposite side has been skewed by breakage and an attempt at repair. The notches are broad, deep, and asymmetrically "u" shaped so that the distance from the deepest part of a notch to the lateral edge is noticeably shorter than from the same point to the basal edge. This gives the haft an expanding appearance. The corners of the basal edge are rounded and polished. Basal width is about 5 mm less than greatest (estimated) blade width which was just above the notches. The basal edge is slightly indented near the middle due removal of a single large basal thinning flake from each face. Those flakes were each about 13 mm in length and 6 mm in width at the basal end, and both ended in step fractures 2-4 mm above the notches. The outer parts of the basal edge are considerably thicker and duller than the central part, although they do not appear to have been ground or crushed. Overall, the shape and other characteristics of catno 7900 conform to those of the Hanna type (Wheeler 1954).

The point has suffered severe tip damage extending onto an adjoining part of one face, down one edge through the shoulder tang, possibly even to the base. Part of the tip and a small part of one face snapped off in one direction, while a second flake, originating near the tip, removed another part of the tip, the upper mid-section of the opposite face, and all of a lateral edge including the shoulder tang. There are a couple of small chips missing from the base on the side with the greatest damage. These may have been due to rebounding haft forces. Altogether, the damage is consistent with a substantial direct impact on the tip. Additional chipping and crushing along part of the damaged edge indicate that a futile repair attempt was made. There are chalky white residues in deeper crevices of one face including some of those due to impact damage. Presumably these are calcium carbonate. On the other face there are microgranular rusty red residues in deeper crevices along the undamaged edge and along the base. These are probably blood residues and, if so, are evidence that the point came in contact with a bloody substance, probably as a result of penetrating the body of a game animal. Application of the Thomas (1978) discrimination equations to a combination of actual and estimated measurements for catno 7900 yields values of $C_{dart} = 11.61$ and $C_{arrow} = 11.84$. These are too close for a dart/arrow determination.

Chipped Stone Debris

The small sample of chipping debris from Layer XXI (Table 25.4) consists entirely of flakes and shatter. The dominant material by weight is quartzite. However, by number, Knife River Flint, specifically, and high quality fine grained materials, generally, are clearly dominant. Such a wide array of chipping technology is represented, from decortication of raw material, through secondary and tertiary reduction, to fine bifacial retouch, that one has the impression that this is a very small portion of a much larger assemblage.

Bone Tools

The bit of a bone chopper made on an unidentified large mammal long bone shaft from XU 5 (catno 7972) is the only bone tool recognized in this layer.

Faunal Remains

A bison femur from XU 5 provided a radiocarbon sample (S-2062) weighing 295 g, and another bison bone from the deep profile provided a second date (S-1770) on Layer XXI.

Bison, NISP=53: see Table 25.6. A calf in age group B is known from two lower molars, and the basisphenoid is small enough to represent this animal; hence all of the skull parts may be derived from a single calf. The post-cranial remains also include parts of calf (MAU=1.0) as well as cow (MAU=1.0) and bull (MAU=0.5). Although some of the fragments cannot be assigned to gender it appears that most of a cow or calf right forelimb is present. Large body portions seem to have been transported to the site for further processing, and other portions from the same animals must be present in a bone scatter outside the limit of the excavation. Cut marks on five bones and impact scars on many shaft fragments represent defleshing and marrow retrieval. Carnivore furrowing on a proximal tibia and a tooth puncture on the lateral malleolus comprise the only tooth marks. Weathering is slight (Stage 1) and rootlet etching superficial.

Size 5-6 mammal, unidentified, n=65: two tooth, 20 rib, nine scapula, 34 long bone shaft fragments. One long bone fragment is the bit of a chopper.

Deer or Pronghorn, NISP=1: femur shaft. This bone is heavily charred.

Size 2 mammal, unidentified, n=2: long bone shaft fragments. These bones probably represent either ground squirrels or pocket gophers.

Vole, NISP=5: two I^1s, M^2, distal femur, tibia. From the occlusal pattern on the molar, this animal can be identified as a meadow vole (*Microtus pennsylvanicus*).

Unidentified mammal, n=668: fragments of which only 37 (4-12 cm) are longer than 4 cm. Most of the seven charred and 158 calcined fragments occurred in F21-a. Such a high frequency of calcined fragments must reflect a very hot fire.

Discussion. Portions of bison ranging in age from a long-yearling (i.e., age group B) to both

Table 25.5. Vertebrate remains from Layer XXI.

Size, Taxon	Number XU 4	XU 5	XU 6	Total	Weight XU 4	XU 5	XU 6	Total
6, Bison	7	36	10	53	361.7	1,502.7	543.7	2,408.1
5-6, mammal	16	43	6	65	120.1	292.2	95.6	507.9
5, Deer or Pronghorn	-	1	-	1	-	26.2	-	26.2
2, mammal	1	1	-	2	0.1	0.1	-	0.2
1, Meadow Vole	-	5	-	5	-	0.1	-	0.1
-, mammal	390	269	9	668	205.2	265.0	27.4	497.6
Totals	414	355	25	794	687.1	2,086.3	666.7	3,440.1

Table 25.6. Bison elements and fragments from Layer XXI.

Element	NISP	MNE	Calf	Cow or Calf	Cow	Bull
Basisphenoid	1	1	-	-	-	-
Mandible[a]	4	1	1	-	-	-
Rib	8	4	-	-	-	-
Scapula	5	3	-	1	-	-
Humerus	1	1	-	-	-	-
Radius	1	1	-	-	-	-
Ulna	2	1	-	-	-	-
Radial carpal	1	1	-	1	-	-
Intermediate carpal	1	1	-	1	-	-
Ulnar carpal	1	1	-	1	-	-
Carpal 2+3	1	1	-	1	-	-
Carpal 4	1	1	-	1	-	-
Metacarpal III+IV	2	2	-	-	2	-
Front 1st phalanx	3	3	-	2	-	-
Front 2nd phalanx	1	1	-	-	-	-
Front 3rd phalanx	2	2	-	-	-	-
Femur	2	2	-	-	-	1
Tibia	7	2	-	1	-	1
Lateral malleolus	1	1	-	-	-	-
Metatarsal III+IV	3	3	2	1	-	-
Hind 1st phalanx	2	2	-	-	-	2?
Hind 3rd phalanx	1	1	-	-	-	-
Prox-lat sesamoid	1	1	-	-	-	-
Distal sesamoid	1	1	-	-	-	-

a. mandible in age group B.

Table 25.7. Modified vertebrate remains from Layer XXI.[a]

								Fracture States				
Size, Class	Cut	Burn	TMk	Dig	Weat	Etch	Teeth	Recent	Dry	Fresh	Whole	Total
6, Bison	5	-	2	-	3	40	4	4	7	26	12	53
5-6, mammal	-	-	-	-	*	*	2	5	7	51	-	65
5, Deer or Pronghorn	-	1	-	-	-	1	-	-	-	1	-	1
2, mammal	-	-	-	-	-	-	-	-	-	2	-	2
1, Meadow Vole	-	-	-	-	-	-	3	-	-	1	1	5
-, mammal	-	165	-	-	*	*	-	*	*	*	-	668

a. TMk, tooth-marked; Dig, digested; Weat, weathered; Etch, root-etched; Total = sum of teeth plus the four fracture states; *, not recorded.

adult cow and adult bull are represented in Layer XXI. The long-yearling implies a summer or early fall season of occupation. Filleting and roasting of meat and marrow cracking of limb bones appear to have been the main subsistence activities. A smaller animal, either deer or pronghorn, may also have been consumed, but most of its remains must lie beyond the excavation limits.

Interpretation of Layer XXI

The excavated portion of Layer XXI probably represents a disposal area at the edge of a campsite. While it is possible that the exposure actually reveals a living area, we favour the disposal area interpretation for several reasons: (1) the absence of burned soil beneath true hearths is very unusual, but it is predictable for hearth residues in a disposal area; (2) indications of complexity in the relatively small chipped stone and vertebrate bone samples suggest that they are small portions of much larger collections; and (3) surface undulations and slope would have been uncomfortable for sitting or working had the exposed area been a central part of a campsite, but would have been of no consequence in a disposal area.

If this was a disposal area, then the most likely place for an adjoining campsite would have been farther from the creek. Since it is not clear exactly where the creek bed was located at that time, the campsite may have been immediately north in which case additional excavations will reveal it. However, it may have been immediately south in which case the creek bed has destroyed it by erosion. One of the additional implications for the disposal interpretation is an adjoining occupation which was prolonged for more than a few days, so that debris around hearths had accumulated to the point that it impaired use of the hearths and required removal from the camp. In turn, this implies a commitment to maintaining rather than moving activity areas. Consequently, one would expect that dwelling structures were part of the encampment.

The occupants of the site were bison hunters belonging to the McKean series, specifically, users of Hanna type projectile points. They brought in large portions of several bison, plus part of one deer or pronghorn, and consumed them at the site. Coarse rock, fired in the hearths, was used for bone boiling and probably also for bone roasting and breaking. All of the rock could have been collected in nearby surface deposits. They also collected small amounts of quartzite and petrified peat from sources in the surrounding district, but relied most heavily on the exotic material, Knife River Flint. These people clearly had access to a substantial supply of that material and were able to ignore local chipping materials for the most part. The season of occupation was probably summer as indicated by the presence of bison calf bones in the long- yearling category. The age is estimated to have been in the range of 2050-1750 BC (cal 4000-3700 BP; Table 3.6).

Below Layer XXI

Controlled block excavations ended with Layer XXI. We did, however, make an 18 cm deep section pit through F21-b which showed that cultural materials were absent below Layer XXI except for a few pieces immediately below the layer. In addition, we made a test pit about 50 cm south of XU 5 which extended to 135 cm below Layer XXI. It revealed a continuation of clay and silt below Layer XXI, apparently lacking cultural remains, to an additional depth of 20-25 cm. Beneath that lay thick alternating layers of gravel, sand and clay suggesting a river or creek-bed environment uninhabitable by humans.

Chapter 26

Discussion and Conclusions

Introduction

Middle and Late Prehistoric archaeological remains recovered from the Sjovold site have provided an exceptional opportunity for study of long-term use of a small riverbank locality near the northern edge of the Great Plains. The remains may be characterized as moderately rich in amount and variety, well preserved, minimally disturbed and within separate occupation layers of fairly high integrity. The potency of this record is underlined by the fact that it was obtained, using more or less conventional archaeological excavation methods, from an area only 11-24 square meters in size. Objectives of the project — assessment of archaeological age, identity and contents of each layer, together with interpretation of occupation activities — have been fulfilled for all layers to some degree and for some quite extensively. We now know that the Sjovold site was first occupied as a temporary campsite by users of Hanna projectile points about 4000 years ago, shortly after it emerged as a habitable surface from the bed of the South Saskatchewan River. Thereafter, the site was revisited periodically by a series of bison-hunting groups at intervals of about 165 years. The record is fairly regular and distinct until about 500-700 years ago. Surface and near surface deposits contain only very sparse remains relating to the past 500 years.

Ethnohistoric records suggest that the long broken ridge of land known as the Missouri Coteau, which runs past the Sjovold site, was a northern Plains "war-road" during the early part of the historic period. This made the whole Elbow region a dangerous place to camp. Nevertheless, there are a couple of historic records for aboriginal camps in the Sjovold vicinity during the mid 1800s and, indeed, there are sparse traces of aboriginal occupation remains on the modern surface near the Sjovold site. These support the inference that the Sjovold locality continued to be used as a temporary Indian camp into historic times. During the first two-thirds of the twentieth century, the Sjovold locality was used for picnics by members of the local community. Evidence for those activities is also scattered sparsely over the modern surface. The Sjovold site continues to be used occasionally as a Boy Scout camp and remains of those activities may also be found on the modern surface. The focus of our project, however, was on aboriginal occupations and hence on mainly subsurface remains.

Culture Chronology

One of the problems arising out of previous research was a need for more robust knowledge of the sequence of archaeological cultures in the Central South Branch Region (CSBR). At the time that Sjovold investigations were initiated the state of prehistoric archaeology in the CSBR could only be described as poorly developed. Although archaeological remains were known to be abundant, knowledge of the cultural sequence was weak and relied heavily on comparisons with materials identified and dated elsewhere. The number of excavated components was few and included no long stratified multicomponent sites against which isolated radiocarbon dated components could be evaluated. Nevertheless, the general sequence established in adjoining prairie regions seemed to be confirmed by surface recoveries and by radiocarbon-dated remains in the CSBR and, therefore, was adopted.

As a result of Sjovold investigations, we are in a position to re-evaluate and enlarge upon middle and late portions of the northern Plains sequence adopted for the CSBR. With respect to the 4000 year long segment of time represented at the Sjovold site, the previously proposed culture history is generally confirmed, but with refinements. Sjovold history begins in Layer XXI with a Hanna occupation dating to about 1900 BC. Layer XX, at about 1800 BC, begins a Pelican Lake sequence with one of the oldest Pelican Lake components known for the northern Plains. Pelican Lake is seemingly the most abundant but least well-known archaeological grouping on the northern Plains. It is identified here on the basis of straight-based, corner-notched projectile points. Layer XIX, a couple of hundred years younger than Layer XX, is Pelican Lake of the same type. By size, the projectile points in these layers are a mixture of dart and arrow points (Table 26.1). These observations contribute to mounting evidence that bows and arrows were not only part of the Pelican Lake tool kit, but part of the tool kit from the beginning of Pelican Lake. It is now clear that Pelican Lake, and not Besant, is the series we should be examining for the introduction of the bow and arrow to the northern Plains, an event which seems to have occurred almost a millennium earlier than is generally believed.

Several occupation layers above Layer XIX are unidentified as to archaeological complex or series. However, Layer XIV, dated about 700 BC, contains a previously un-named type of projectile point to which we have given the name "Outlook Side-notched." We believe that this is the initial, most enduring and prominent of several types characterizing the Besant series. That an archaeological complex or series can be characterized by more than one projectile point type and that particular types may change slightly through time are ideas that are implicit in the observations of previous researchers. However, these ideas have explicitly guided our interpretation of the Sjovold sequence with the naming, definition and chronological positioning of three main types for the Besant series — Outlook Side-notched, Sandy Creek and Bratton. It is noteworthy that the oldest Besant projectile points appear to be arrowpoints. This is new information. Our previous knowledge of Besant held that atlatl darts were dominant throughout the series and that bows and arrows made only a late transitional appearance.

The middle of the Besant series is represented in Layer X by a mixture of side-notched and corner-notched projectile points dating to about 250 BC. We have identified the points as belonging

Table 26.1. Discriminant equation values and classification decisions for measurable projectile points from the Sjovold site.[a]

Layer	Catno	C_{dart}	C_{arrow}	Class
III	853	3.49	5.84	arrow
IV-V	948	11.51	8.42	dart
VI	1059	0.09	4.81	arrow
VII	2726	12.45	12.79	no decision
X	1847	9.56	14.37	arrow
X	1848	9.84	11.68	arrow
X	3598	5.52	8.34	arrow
X	3670	14.57	13.28	dart
XI	4562	6.85	9.16	arrow
XI	5259	7.18	10.81	arrow
XII	5378	25.89	22.46	dart
XIII	5798	2.35	6.57	arrow
XIV	6233	7.16	9.81	arrow
XIV	6263	9.86	10.97	arrow
XIV	6264	11.09	11.24	no decision
XIV	6265	13.22	12.86	no decision
XIV	6790	3.31	7.32	arrow
XIX	7361	19.40	16.67	dart
XIX	7436	4.79	6.80	arrow
XIX	7511	6.44	7.02	no decision
XIX	7710	12.76	10.68	dart
XX	7820	4.74	6.04	arrow
XXI	7900	11.61	11.84	no decision

a. Discriminant equations after Thomas (1978).

to the Besant and (tentatively) Late Pelican Lake series. The absence of corner-notched forms in early Besant occupations followed by their appearance along with side-notched types midway through the Besant sequence is a puzzling situation, but one which is duplicated in other sites about the same age. One possible explanation is that Pelican Lake peoples who made corner-notched points were driven to the margins of the Plains by Besant peoples and later merged with Besant. Another possibility is that knowledge of Pelican Lake is simply so weak that our present definition fails us. For example, we suspect that it is inappropriate to refer to all corner-notched points as Pelican Lake. There must be many corner-notched types, one or more of which should be ascribed to the Besant series. The late part of the Besant sequence, the period of Besant florescence elsewhere, either is not represented in the Sjovold site or else is poorly represented by the unidentified materials of Layers VIII and IX. One of the original purposes of Sjovold research was to determine whether the site contained a Besant component with pottery. It turns out that although the site contains several Besant components, none of them has pottery.

Layer VII contains materials dating to about AD 400 which may be a form of Avonlea. It includes a small sample of knotted cord-impressed pottery of a type generally thought to be associated with the Avonlea complex, and a straight-based, straight-sided, side-notched projectile point which seems to be an example of the ill-defined Samantha type. It has been claimed that Samantha is intermediate between projectile point types of the Besant series and the Avonlea complex (Kehoe 1974), but the supporting evidence has never been published. The next layer (VI), dating to about AD 650, is definitely Avonlea. It contains examples of the distinctive parallel-grooved pottery and tiny side-notched arrowpoints diagnostic of the complex. The Layer VI occupation appears to fall in the middle of the Avonlea time span for this region (Morlan 1988, 1993a).

A different complex, represented by Prairie Side-notched projectile points and dated to about AD 750, appears in Layer IV-V. In the northern Plains Prairie Side-notched points became the dominant type about AD 800 and remained so until about AD 1300. The Sjovold occurrence in Layer IV-V is, therefore, toward the beginning of Prairie Side-notched dominance. Northern Plains archaeologists have tended to view Prairie and Plains Side-notched projectile point types in a different light than earlier point types. Since both Prairie and Plains types seem to have been associated with several Late Prehistoric complexes it is generally not possible to identify the particular complex represented on the basis of these projectile point types alone. This is the problem in Layer IV-V. However, Layers II and III, dating about AD 850-1350, do contain additional identifying clues. As a result, we have been able to attribute them to the Moose Jaw complex, an archaeological taxon that was named by Boyd Wettlaufer (1955) 40 years ago but which has been neglected since that time. Moose Jaw complex ceramics, which Malainey (1991) has recently given the collective name, "Wascana ware," are present in Layer II. Artifact types including a chipped stone axe, chithos and an abundance of bone tools, which collectively seem also to be characteristic of the complex, were found in Layer III. With the identification of this complex we are almost within reach of ethnic identifications. Malainey has speculated that Wascana ware ceramics may have been associated with Gros Ventres Indians. We suspect a Siouan association and present a line of comparative evidence which may indicate a more specific Assiniboine attribution. In any case, Layers II and III serve as the vehicle for re-establishing a complex which for many years had been omitted from the regional sequence.

Between Layer II and the modern surface is one unidentified occupation layer. This seems like an unusually sparse record for the past 500-600 years. We presume that the small area sampled may be the cause for this shortcoming since surface and ethnohistoric evidence suggest that aboriginal use of the site continued into historic times.

In brief, the major culture/chronological contributions of the Sjovold sequence are as follows:

1. It is the first long well-dated stratigraphic sequence to be investigated in the region,

containing more than 20 separate occupations extending from a Hanna expression of the McKean series (1900 BC) to the Moose Jaw complex (AD 1350) with sparse traces continuing into the historic period.

2. Two early Pelican Lake occupations have been added to a very poorly known segment of the regional sequence.

3. The early portion of the Besant series is strongly represented, including the oldest Besant occupation on the northern Plains. The Sjovold sequence provides an opportunity to observe and define the cumulative introduction of the three main Besant side-notched projectile point types.

4. A mid-series Besant occupation contains both side-notched and corner-notched points and offers an opportunity for consideration of the notion of Besant/Pelican Lake merger or the future definition of a corner-notched type belonging to the Besant series.

5. An occupation containing a Samantha projectile point and Avonlea pottery appears in an intermediate position between Besant and Avonlea.

6. Strong representation of the Moose Jaw complex in upper layers has prompted reintroduction of that long neglected taxonomic unit into the regional and northern Plains sequences.

Culture Content

Another problem arising out of previous research is that our knowledge about the contents of most archaeological complexes in the CSBR is generally deficient. Within the time period covered by Sjovold occupations, Pelican Lake, Avonlea and Moose Jaw groupings are especially poorly known. Our samples of Sjovold occupation remains, although representing only small surface areas, are remarkably robust and varied. They include good examples of features, tools, and other occupation debris in a context of fairly minimal disturbance or mixture. This has facilitated detailed interpretations of site activities, spatial arrangements, resource use, group composition, seasonality and so forth. The campsite features are particularly interesting. For example, a shield-making pit is a feature type not previously recognized in an archaeological context. The kiln hearth, stone boiling rings and roasting trough may also be firsts, and the hide-smoking pits are particularly good examples of their kind. The array of hearths is also instructive. Few archaeologists realize how varied the common surface hearth can be, in size, depth, fuel burned, debris contents, and intensity and duration of use. The Sjovold sample illustrates this variety rather well and shows the considerable interpretive potential for detailed analysis of such common features. At present our overall stock of campsite feature types and their variations is not sufficiently advanced to allow distinctions between one complex and another on the basis of feature peculiarities. It is to be hoped that additional research may eventually permit such distinctions.

Our knowledge of prehistoric tool kits has also been enriched by Sjovold investigations. The bar and cylindrical abraders in Layer VII are unusual additions to the Avonlea complex. Moreover, the facsimile projectile point in Layer IV-V and the bone gaming pieces in Layer XIX are rare for the region. The most intriguing group of tools, however, may be that found in Layer III among which was an unusually rich array of bone tools including pressure flakers, awls, an eyed pendant or needle; a chipped and notched stone axe; two chithos; and Wascana ware pottery. These elements, particularly the bone tool assemblage, stone axe and chithos, seemed at first to be a little out of place in a northern Plains context. They seemed more akin to archaeological complexes in the adjoining boreal forest. Yet, our comparative work shows that a previously identified, but long neglected northern Plains entity, the Moose Jaw complex, actually contains such items. Consequently, in this case the artifact discoveries were not simply enlarging upon the content of an accepted complex, but serving as the basis for reinserting a forgotten complex into the cultural sequence. Possible boreal forest or eastern woodland affinities may be significant for understanding the Moose Jaw complex in the long run. For now, re-establishment as part of northern Plains culture history is a step forward.

Resource Use

Sjovold investigations have aided our understanding, or at least have improved our awareness, of the aboriginal uses of certain resources. For example, coarse rock was brought to the site from adjoining valleys slopes in fair quantities by almost all occupants. It appears that this rock served a variety of uses including chippable stone for larger choppers and scrapers, foundation rings for leather boiling vessels, hammerstones and abraders. However, the principal use, by a large measure, was as a medium for heat storage and transfer from campfires to materials such as water, meat, plant foods and leather for purposes of food preparation, bathing and manufacturing. Previous research has shown that granite and gneiss are the most ideal rocks for the kinds of heat transfer required by these processes and, indeed, granite (48.6% by weight), gneiss (13.1%) and grano-gneiss (5.7%) are the top-ranked rock types recovered from the Sjovold site overall. Nevertheless, the combined proportion of granite, gneiss and grano-gneiss in the site (67.4%) is very close to the combined total of naturally occurring proportions of these materials in local sources (68.1% total comprised of 35.2% granite, 19.2% gneiss and 13.7% grano-gneiss). This obviates any inference that granite and gneiss were being selected by prehistoric inhabitants at the Sjovold site. In fact, all the available rock types, even limestone, show evidence of contact with fire. Therefore, one may conclude that the gathering of coarse rock for use at the Sjovold site reflects near random selection from local sources.

In a general sense, the use of food resources follows the classic northern Plains pattern with an overwhelming reliance on bison, with large canids in distant second place, and with all other large, medium and small animals only a trace. It appears that bison were killed and butchered outside the site and that portions were brought to the site for additional processing and consumption. This is indicated by relatively small amounts of highly fractured bone and the representation of only selected portions, often from more than one animal, in each layer. The presence of other animals in the local resource base is indicated by traces of their skeletons in the Sjovold sample. Yet, their numbers are so far below any reasonable projections of natural abundance that cultural selection clearly seems indicated. For most subsistence needs, these people simply preferred bison over all other game animals.

A closer look at the Sjovold faunal remains reveals a remarkably diverse array of dietary supplements as well as many suspected non-dietary uses of animal resources. Having carefully considered the potential roles of avian and mammalian carnivores in the formation of the Sjovold record, we find that these agencies account for the presence of most mammals in size classes 1-3 (the voles, mice, ground squirrels and leporids). However, judging from bone modifications and site context, some leporids also contributed to the human diet (Layers III, VI, XIX). Deer and/or pronghorn were procured during many occupations (Layers III, IV-V, VII, VIII, X, XIII, XX, XXI), while in others the presence of their remains is more difficult to interpret (Layers II, XII, XIV). Freshwater clams appear among the consumables in at least two occupations (Layers VII, IX) and bird's eggs in at least two others (Layers XIII, XV).

We can speculate on a wide variety of non-dietary uses of faunal resources. Animals that may have been procured for their skins include wolf (Layer X), unidentified large canid (XV), lynx (XIV), beaver (IX), badger (III), rabbit or hare (XIV), and possibly fisher (VI) and marten or fisher (III, XIX). Some of these animals, such as marten or fisher, may have provided clothing ornamentation, rather than construction materials, and this use may also apply to porcupine (III, quills?) and Lynx (II/III, bead byproduct). Ornamentation may also explain some of the bird remains (Layer XI, raven claw; XVI, eagle talon; XIX, feather-bearing wing tips of three species). Utilitarian tools also account for some faunal occurrences (Layer III, moose; XX, pronghorn). Finally, we suspect that a mega-mammal bone found in Layer VI may have had magico-religious significance and might even have been part of a medicine bundle.

As is often the case, interpretation of canid use at the Sjovold site has proven difficult in the face of small samples and difficulties in identifying species on the basis of individual teeth and post-cranial elements. It appears that wolf, dog, coyote and swift fox are all present, and some progress has been made in distinguishing certain post-cranial elements of dog from wolf and coyote. In one case (Layer XX) it seems clear that dog or coyote was eaten, and in another occupation (Layer X) we suspect that a wolf was procured for its skin. Large canid skins may have been valued as camouflage robes for stalking bison. The muzzle may have been left unbutchered so as to keep the shape of the face and provide a source of non-human scent, in which case recoveries of isolated teeth might be the only clues that such a robe had been discarded on the site (Layer VII). Dogs may also have been used as pack animals and for pulling travois (Layers III, VI, XIX).

Although use of plants for food was not detected, such use is not ruled out. Direct evidence for plant use was discovered in the form of residues from the burning of wood and bison chip fuels. Abundant potable water was close at hand in Sjovold Creek and the South Saskatchewan River. The use of water for cooking and sweat bathing is attested to by quantities of fire-broken rock, stone boiling features and at least one sweat lodge feature.

Analysis of chipped stone debris has revealed some patterns in the use of these resources. Petrified peat is the dominant (by number) chipping material in eight occupation layers including Avonlea, Samantha/Avonlea, part of the Besant sequence, and one Pelican Lake occupation. This is a local material found as slabs eroding from subsurface deposits along the slopes of the South Saskatchewan River valley. The closest known concentration is opposite the Town of Outlook about 5 km north of the Sjovold site. Reliance on local chipped stone resources implies a fairly thorough knowledge of local terrain such as might be acquired through longer term residency. In contrast to this, Knife River Flint (KRF) is dominant in five layers. Its sources lie about 600 km southeast in North Dakota. This suggests reliance on non-local chipped stone and implies that some site occupants had either travelled from or traded to the distant southeast. KRF is dominant in a couple of Besant occupations from the early part of the sequence, the older of two Pelican Lake layers, and the single Hanna occupation at the bottom of the site. In three layers quartz is dominant, one Moose Jaw layer near the top and two unidentified layers near the bottom of the site. Sources of the quartz have not been identified, although we suspect that they could be either local or in the boreal forest to the north. In all three cases the total sample of chipping material is very small. Swan River Chert, a material found in surface tills across southern Saskatchewan, especially in east-central and southeastern areas, is dominant in Layer III which has been identified as belonging to the Moose Jaw complex. Such chipped stone sources are consistent with other evidence in the layer attesting to woodland affinities for the complex. Petrified wood and quartzite, both of uncertain source but possibly from local deposits, are dominant in two layers (I and IV-V). Both are unidentified to complex and represented by small chipped stone samples.

Landscape Change

Investigations by earth scientists in the Sjovold locality have helped us to understand the state of central South Saskatchewan River valley landscape during the past 13,000 years. During this time there have been some monumental changes, perhaps the most stunning being a 180° reversal in the flow of the South Saskatchewan River. Sometime between 12,500 and 10,000 years ago the river stopped flowing south from Lake Saskatchewan into the Qu'Appelle spillway and started flowing north

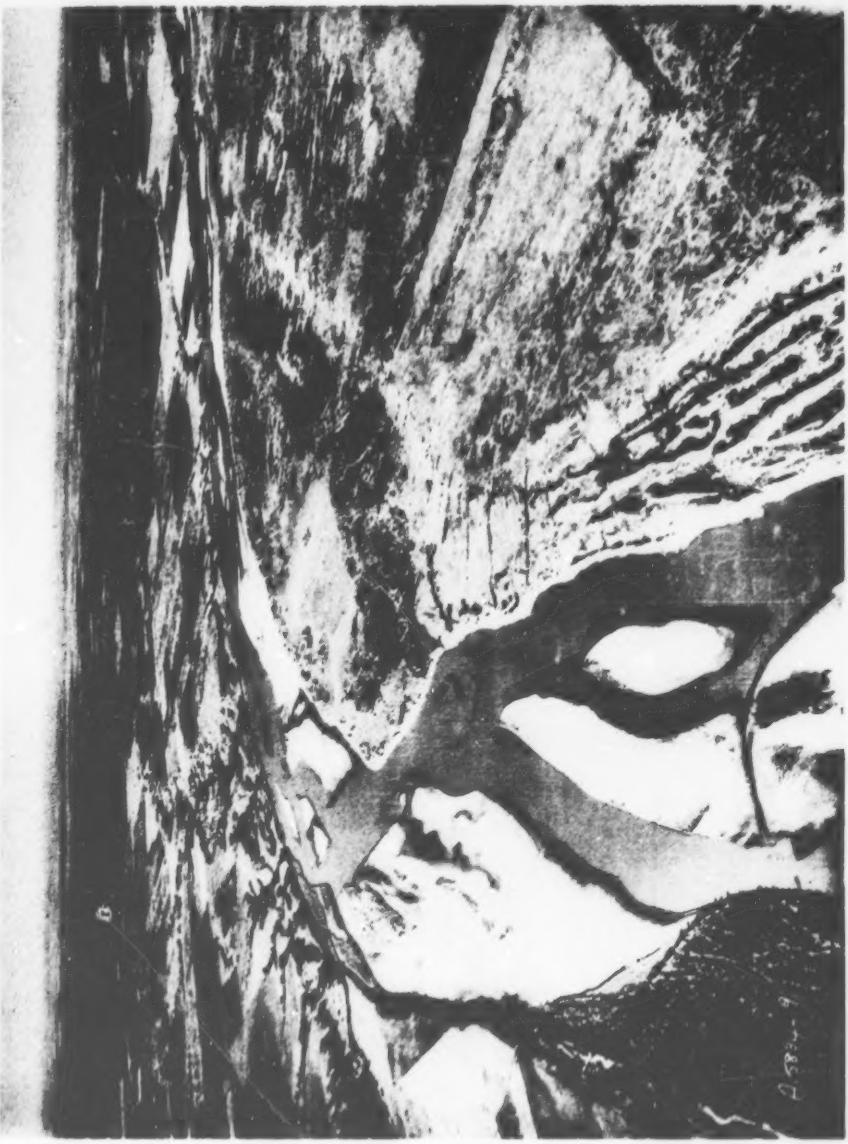

Figure 26.1. Oblique aerial view, from the southeast, showing the Sjovold locality at the junction of "Sjovold Creek" and the South Saskatchewan River. NAPL No. A5834-9, 2 November 1937, produced from the collection of the National Air Photo Library with the permission of Energy, Mines and Resources.

into the northwestern arm of Lake Agassiz. From about 10,000 to 4500 years ago particulars about the state of the landscape are unknown since there are no sediments at the Sjovold site dating to that period. Although the site clearly remained a part of the South Saskatchewan River valley we cannot be certain exactly what part. Presumably, it was part of the river bed, and sediments were either not being deposited or were being deposited and repeatedly eroded. This is a subject for further study. Between 4500 and 4000 years ago, however, the river regime changed again, and alluvium began to accumulate at the Sjovold site. Within a few hundred years it reached a thickness of 5 m, eventually rising above the average level of river water. Shortly thereafter, the first human habitation of the surface occurred, the occupants belonging to the Hanna complex.

From the time of first occupation to the present, sediments have continued to accumulate on the Sjovold site as a result of aggradational processes such as periodic ice-jam flooding and deposition by wind. These deposits are indicative of an environment and river regime generally similar to that of today with the exception of recently diminished river flows due to construction of the Gardiner Dam in the mid-1960s. Opal phytoliths indicate that occupation surfaces toward the beginning of the sequence may have been slightly more tree-covered than grass-covered. This is to be expected for a lower and probably damper surface. As the surface began to rise higher above river and creek water, the ridge bearing the Sjovold site gradually assumed the contours and grass-covered surface we see today. Areas adjoining the ridge to the east and west did not accumulate sediment at quite the same rate and, therefore, presumably remained slightly lower, damper and wooded as they are today. About 1800 years ago there may have been a change in the orientation of the creek bed and mouth into their present positions. This may have occurred about the time of occupation Layer VII or VIII. Prior to that time the creek may have followed a meander that curved south against the wall of the creek valley and then north along the east shoulder of the Sjovold site ridge. Accordingly, prior to 1800 years ago, the creek may have run roughly south to north past the east edge of the site, emptying into the river approximately 150 m farther northeast. This proposition is based on the existence on an abandoned meander scar in an appropriate position and an observed shift from mixed alluvial and aeolian sediments to mainly aeolian sediments at Layer VIII. Whether or not such a change occurred at the time proposed is a subject for additional study. However, even if there was a creek reorientation in the midst of the sequence, it may not have made much difference to access or use of the site. While the creek may have changed, the river seems to have maintained a remarkably stable position. For the past 4000 years its water level has been roughly constant and it may even have occupied its current bed with primary flow against the west bank during most of that time.

Site Selection

This brings us to consideration of why the Sjovold site is situated where it is (see Fig. 26.1). What induced people to come to this specific spot and to stay, briefly, more than 20 times over 4000 years? In attempting to answer the question we can resort to several kinds of information, namely: (1) interpretations of materials recovered from the site in terms that show what people were doing there and when; (2) the landscape and its potential for use by prehistoric pedestrian hunter-gatherers; (3) current archaeological knowledge of prehistoric northern Plains site types and settlement systems; and (4) ethnohistoric examples of aboriginal use for this site or sites in similar situations.

To set the scene we must first outline the highlights of multilayer interpretations about activities and the timing of occupations. In brief, although the activities from one layer to the next are quite varied — ranging from outdoor to sheltered cooking, and including stone tool manufacture and maintenance, shield making, sweat bathing, pottery making, hide working and gambling — all are campsite activities. Therefore, in gross terms the Sjovold site is a campsite. One qualifier on this classification is the duration of occupation. To the extent that we can distinguish between duration and intensity of occupation it appears that all occupations were brief, lasting from hours or days to, at most, a few weeks. Accordingly, the Sjovold site was a temporary campsite. Seasonality of occupation was restricted mainly to fair weather (April to October). Out of 13 layers for which seasonality could be estimated, only one (Layer XIV, early winter) did not fall into this range. Therefore, the site type could be further characterized as a temporary fair weather campsite. Another qualifier concerns the principal food consumed which, in spite of the broader range of foods available in the Sjovold locality, was overwhelmingly bison. This makes the Sjovold site a temporary fair weather bison-hunters' campsite. Yet another qualifier is the origin of occupants, or at least the extent of travel and/or trade just prior to Sjovold site visits. Such previous associations are indicated by use of local and non-local chipped stone sources. According to this criterion, Sjovold site occupants were a mixture of local and non-local groups. Thus, the site type can be further elaborated as a temporary, fair weather, local and non-local, bison-hunters' campsite. Having classified the site according to length of occupations, seasonality, nature of occupants and kind of activities, we know a good deal about the what, when and who of the site, but still do not understand the why.

Review of the geographic context provides some ideas about potential values in the locality for bison hunting populations. The site is located on a ridge within the South Saskatchewan River valley near the mouth of Sjovold creek. The elevation of the site is, depending on the occupation layer, about 1-5 m above the current level of creek and river waters and about 65 m below the level of the upland plains. The site is sheltered from most winds by virtue of its lower elevation with respect to surrounding plains, and by the presence of creek-bottom trees on the opposite site of the creek to the south, and on the site borders to east and west. Shelter is one of the attractive features of the Sjovold site. The ridge on which the site rests is grass-covered, relatively flat and well-drained providing about 480 m^2 of prime occupation space. This could be expanded onto the grassy slopes to the north and east, and even onto the adjoining uplands, generally at the expense of greater slope and less protection from trees. It could also be expanded into the trees to the west at the cost of greater slope and greater restrictions in campsite feature emplacements. For temporary fair weather encampments, size of area would have posed almost no restriction to groups of small, medium or large numbers, particularly with the huge overflow areas to the north and northeast. The distance to creek water is about 6 m south, and to river water about 90 meters east. Unlimited water of easy access and fairly good quality is one of the prime values of the location. The same waters provide low to moderate opportunities for angling fish.

The woods along the creek bottom provide construction materials and dry wood for campfires. Bison chips were probably abundant on the valley slopes and uplands in pre-agricultural times and could have supplied another almost unlimited supply of fuel. The woods in the creek, nearby gullies, and on the sand hills bordering the opposite side of the river have the highest capacity for the support of ungulates and other game animals of any district within several kilometers of the Sjovold site. Coarse rock for camp uses is abundant and easily accessible on the slopes of the river and creek valley adjoining the site. Portions of the coarse rock supplies could have served a limited part of the (coarser) chipped stone needs of site inhabitants. However, chipping stone, though sparsely sprinkled among the rocks of surface tills and valley bottoms is thought not to be a significant resource in the Sjovold locality. A concentration of chippable petrified peat is found in river bank exposures several kilometers north of the site. Sand bars in the river offer staging areas for large migratory birds, but there is otherwise little productive capacity for waterfowl in the immediate vicinity. The Sjovold locality features a high degree of habitat diversity for plants. There are a large number of vascular plants found in the area which are known to have been used by historic Indians. The majority are perennial forbs and shrubs supplying leaves, stems, bark, buds, flowers, fruits and below ground parts for foods, medicines and manufactures. Plant resources, therefore, may have been of considerable importance to prehistoric inhabitants.

One final contextual consideration is access. Pedestrian access to the site during winter is theoretically possible from any direction by groups of any size, across the river ice from the east, down the gradual slopes behind slump blocks to the north, or diagonally up the long creek valley slopes to the west. During fair weather, however, access from the east would be impeded by the South Saskatchewan River. Although there are sand bars and areas of shallow water which would facilitate wading part of the way, except during periods of flood, there is usually a deeper channel on the west side whose passage would have required the use some sort of watercraft by all but the strongest and least burdened of swimmers.

On the topic of previous archaeological research on northern Plains campsite types and settlement systems, we known that prairie valleys, including those of rivers, creeks and glacial channels, are landforms which contained many elements essential to the subsistence and settlement of ancient bison hunters. Valleys offered shelter, fuel and water together with concentrations of plants, animals and stone resources. It is not surprising, therefore, that such settings contain the richest array of archaeological sites of any northern Plains landscape (Brumley and Dau 1988:90; Richards, et al.

1989:152-160). Richards and his collaborators (1989:154) have estimated, for example, that the density of prehistoric sites within the South Saskatchewan River valley is about five sites per km^2 overall, and much higher in some localities. Site types include base camps, transitory camps, large and small bison kills, the odd fishing station, stone quarries, stone cairns, caches, human burials, lookouts, vision quest sites, and ceremonial monuments such as medicine wheels (Adams 1976; Howes 1982; Brumley and Dau 1988:84-94; Richards, et al. 1989:152-160).

In comparing the Sjovold site to site types recognized to date one finds that most known types can be quickly eliminated. Sjovold is not a base camp. Its remains are not sufficiently abundant to meet the characteristics of that type. Neither is it a bison kill or a special processing area associated with a kill. The amounts of bison and portions present do not conform to those of a kill site. It is not a campsite associated with a fishing station (no significant fish remains or fishing apparatus) or a (chipped) stone quarry camp. The chipping debris in the site does not support such an interpretation. Although extensive use has been made of coarse rock in the Sjovold site, most of it was used in the service of cooking activities. It seems unlikely that this resource, so widespread in glacial deposits across the surface of the region, would have been a principal reason for site selection. Stone cairns, human burials, caches and boulder structures such as medicine wheels have not been found at or near the Sjovold site. However, it would not be surprising if such sites were discovered in the general vicinity. The contents, interpretations and location do not fit with the requirements for bison lookouts or vision quest sites. High elevation and a good view is needed for one; a prominent, remote, splendid location of difficult access for the other. This leaves us with a comparison to transitory campsites. Unfortunately, while evidence for suspected transitory campsites is fairly abundant, few of them have been investigated in detail.

On the basis their experience in southeastern Alberta, Brumley and Dau (1988:91-92) note that valley bottoms contain the fewest sites (including buried camps, bison kills, bison kill/processing areas and a few stone circle sites), many of them extensive and repeatedly used and all in close proximity to permanent water and wood. Site density increases along the bases and valley walls where all the bottom-lying site types are included with emphasis on stone circle sites. They found that the greatest density and diversity of sites is found on the prairie level along the valley margins. Their general impression is that habitation sites on the prairie margin contain less cultural material and reflect briefer occupations than similar sites on valley walls or bottoms. Brumley and Dau postulate that well-watered and wooded valley locales were occupied during all seasons of the year and were particularly important during the late fall to early spring when bison chip fuel was unusable or unavailable.

One of the most detailed studies of a temporary campsite within a river valley is that by Glenn Stuart (1990) of the Cranford site (DlPb-2) on the Oldman River. The Cranford Site is a multicomponent stone circle site on a broad upper terrace about 500 m from the river edge. Excavations revealed a palimpsest of small extended family-size occupations covering perhaps 8000 years of prehistory with clearly identified components dating to the last 4000 years. Included are McKean and Hanna, Pelican Lake, Sandy Creek, Besant, Avonlea and Old Women's (including Prairie and Plains side-notched projectile point types), a sequence which is quite similar to that of the Sjovold site. Season(s) of occupation have not been determined, but the investigator argues that the exposure of the location probably limited its use mainly to fair weather. The duration of occupations was not determined. These variables are important for our purposes and their absence makes a detailed comparison difficult. One very important point of interpretation attempted for the Cranford Site is an assessment of the reasons for site selection. Stuart's (1990:194-199) conclusion is that the site was selected as a camp because of the availability of wood, water, stone for holding down tipi covers and cooking, chipping stone for tool manufacture, and the proximity of game.

In a general way these could also be valid reasons for selection of the Sjovold site. Yet, since there are other sites in the vicinity which could answer the same needs, these reasons do not really answer the question as to why this particular site was repeatedly chosen. Perhaps there are other temporary campsites in the Sjovold locale which were also chosen for temporary fair weather occupancy on a repeated basis. More extensive fieldwork is needed to resolve that issue. However, while working on the Sjovold site we began to formulate another hypothesis about a distinct advantage that it might have held for pedestrian peoples, one which to our knowledge has not been the subject of study in the northern Plains area. In short, we formed the idea that the Sjovold site was a river-crossing campsite.

We begin with the presumption that many kinds of river crossings were possible in prehistoric times. People could have walked across river ice in winter. In fair weather they could have waded through shallow water, and for deeper waters they could have crossed by swimming, rafting or canoeing. We know that historic Indians used all of these methods (Burpee 1907:329, 1908:103; Ewers 1958:94; Kennedy 1961:25; Mandelbaum 1979:100; Tyrrell 1916:329; Wissler 1934:31-34). We can also infer that the method and site chosen would have suited the river conditions and people's crossing needs. For example, if the river was in a state of open water and baggage was light, if people were in top condition and there was little concern for getting wet, then a crossing could have been made at almost any place merely by swimming or by a combination of swimming and rafting. Thus, a war party could have crossed a substantial river at almost any place and time with relative ease. Such *ad hoc* crossings probably left little archaeological imprint and may be beyond our powers of recognition.

However, where requirements called for a dry crossing of substantial amounts of baggage plus numerous people of various ages and physical states, as in the case of a travelling microband or band, then the choice of a suitable crossing place may have fallen into a much narrower range of options. For example, the approaches to such a crossing, particularly the grade and footing of approaches, would have been of prime concern. A band of mixed age and gender, their dogs and themselves heavily laden with possessions, would have preferred a long, gentle, unobstructed approach with firm footing all the way to the water. Once they were at water's edge, the river configuration would have been important. A nearly uniform flow and depth of water, whether shallow or deep, would have been sought so that once the crossing had been started the method would not have to be changed until the opposite side had been reached.

Another consideration would have been construction materials. If the crossing required manufacture of rafts or boats, then it would have been preferable for construction materials to be close at hand or easily brought to the crossing site. Required materials might include logs for rafts, wood for canoe frames and bark or skins to cover canoes. Finally, if the crossing was a large or laborious one, then it would have been important to have suitable campsites nearby in which people could assemble and prepare for their crossing, or rest after they had made the passage. It is easy to imagine that a dry crossing for a camp of 50-100 people would require several canoes and rafts, and that construction, loading, and the several trips required to ferry everything to the opposite side could have involved at least a day's work and at least two night's stay. Since this type of crossing has no name, we introduce the term "preferred crossing."

A preferred river crossing should be recognizable in the archaeological record. It should consist of an appropriate valley and river configuration with adjoining campsites on both sides of the river. There is a substantial body of evidence to support the idea that the Sjovold Site (EiNs-4) was an integral part of a preferred river crossing.

The site is situated about 44 km downstream from the elbow of the South Saskatchewan River. The prairie level along both sides of the river is part of a vast gently undulating tableland known as the Central Saskatchewan Plain, the Sjovold site being near the southwest edge of that plain. Only a few kilometers farther south are two upland areas. One of them, the Coteau Hills, begins about 10 km southwest of the Sjovold Site and is part of the Great Missouri Coteau, a long ridge of hills which marks the transition between the second and third prairie steps. The other begins about 22 km southeast of the Sjovold Site. Known as the Strongfield Uplands, it is an outlier of the Allen Hills. The South Saskatchewan River passes between these two uplands and enters the Central Saskatchewan Plain only a few kilometers above the Sjovold site. Through much of the Elbow to Outlook stretch, the active river channel is generally about 600 m wide, about 1-4 m in depth, with a flow of about 565 m^3 of water per second (flow rate derived from Raby and Richards 1969:64). The stream meanders through a valley which averages about 2.5 km in width and which is incised to a depth of about 50-100 m below the surrounding terrain. As the river passes between the Coteau Hills and the Strongfield Uplands, the valley becomes narrower and slightly deeper. Along this stretch good natural approaches are few and rarely matched by equally good approaches on the opposite side.

As the river enters the Central Saskatchewan Plain the valley broadens rapidly to about 3.8 km, a width which is maintained for about 11 km until the river has passed just north of the Sjovold site.

Throughout this broader stretch of valley, approaches to the water on both sides follow fairly steep grades, in the range of 16-30°. The approach surfaces are variable-textured colluvial and eroded deposits some of which are slippery when wet. The principal exception is a small sand plain directly opposite the Sjovold site where the approach grades are on the order of 2-15° and where footing is fairly firm and dry under almost any conditions (Ellis, et al. 1968:end maps). On the opposite side of the river is the Sjovold creek valley. The area around the mouth of the creek provides several wooded and several grassy camping spaces, one of which is occupied by the Sjovold site. The river banks west of the Sjovold site rise steeply to the prairie level, some 60 m above, through a horizontal distance of about 350 meters. These slopes present their steepest face right at the edge of the river in most places. However, at the creek mouth the slope up and over the Sjovold site is a gentle one. Moreover, midway up the valley walls to the west of the Sjovold site are some gigantic slump blocks behind which are gullies. These gullies could have served as additional camping spaces and as ramps to the prairie level. This situation exists on both the north and south sides of the creek mouth. Thus, people coming to or from the crossing could have traversed the west bank with ease along either the north or south sides of the creek. Having good approaches on both sides of the river, it is clear that the Sjovold locality possesses one of the most important requisites of a preferred river crossing.

As to river configuration in this locality, the present flow of water is clearly suitable to use by shallow draft watercraft, but it is difficult to know how much change has occurred through the years due to natural meandering and to interference caused by the 1960s installation of the Gardiner Dam upstream. A water engineer claims that the Sjovold locality is the only place he knows between the elbow and Moose Woods where water position and flow is highly predictable (Dan Klippenstein, Water Survey of Canada, Regina, pers. comm., June 1993). In his experience the channel in the Sjovold locality is always against the west bank and the flow there is always sufficient for easy boating. Maps going back to 1885 show that the tip of a large sand bar near the west bank once reached as far as the creek mouth, but even the tip of that sand bar would not have been an obstacle to canoes launched from either side of the river. Thus, it appears that the Sjovold locality is exceptional not only for gentle approaches on both sides of the river, but also for a highly predictable stream configuration. This combination of attributes would have made the place nearly ideal as an all-season crossing by methods available to bison hunters.

Recorded sightings of Indians along the stretch of river from the Elbow region to Outlook are few. Nevertheless, they appear to show that there were two good crossing places in the district. One was about 40 km above the elbow, near the town of Riverhurst. The other was about 32-48 km downstream from the elbow at a position which we believe was that of the Sjovold site. The historical observations relevant to the Sjovold locality are given in detail in the Historical Setting of Chapter 1. In brief, the first was made by Henry Yule Hind in July 1858 when, while floating down the South Saskatchewan River in a canoe, he came upon 19 tents of Crees who had just crossed the river. Little is learned from that encounter, because Hind ignored their calls and drifted several miles further downstream before making his camp (Hind 1971:I, 384). The second record was made by the Earl of Southesk during the summer of 1859 (Southesk 1969). He came overland along the east bank of the river from the Qu'Appelle River Valley hunting buffalo while his guides looked after the carts and searched for a crossing place. The place they found was between 20 to 30 miles downstream from the elbow (the Sjovold site is 30 miles downstream from the elbow).

Southesk observed that crossing places were rare along that stretch of river owing to the general steepness and muddiness of the descent to the water's edge. His description of the place they found, coupled with a description of their subsequent path, makes it clear that the crossing was in the Sjovold vicinity and perhaps right at the Sjovold site. In order to allow a dry crossing, Southesk's guides built a temporary canoe somewhat in the shape of a birch bark canoe, but with a flat bottom. Construction materials included local wood for the frame and an oilskin for the covering. The work lasted an evening and part of the next morning. Therefore, they camped on the east shore the night they made the canoe. The next afternoon they crossed in several trips and camped on the west side that night. At the west side camp they found chipped stone debris and tent sites left by Indians who had used the same crossing place before them. Perhaps these were the remains of the group which Hind saw in 1858. In any case, these historic observations indicate that crossing places were rare along this stretch of river and that the Sjovold vicinity contained a crossing place used by aboriginal people.

This brings us to a brief reconsideration of archaeological remains in the Sjovold vicinity. The most striking to date are those of the Sjovold site. Before looking at them, however, we touch upon other archaeological evidence in the local area, as poorly known as it is. The archaeological potential of the east bank opposite the Sjovold is unexplored. As to the west bank, the slopes adjoining the creek mouth have produced the odd piece of chipped stone debris indicating that they were the scene of some prehistoric activities. On a grassy bottom at the edge of the creek about 200 m west of the Sjovold site there are broken bones, chipped stone debris and fire-broken rock revealing the presence of additional campsite remains. In addition, there used to be a small tipi ring site on a slump block within the creek valley about 1.1 km west of the Sjovold site. It was destroyed by road construction about 1960. A much larger site with at least 200 stone rings used to lie on the south rim of the creek valley about 2.5 km west of the Sjovold site. It, too, has disappeared, the rocks having been collected for use as riprap along the river. A giant limestone erratic still lies on the north side of the creek about 2 km northwest of the Sjovold site. Its crevices contain blue glass beads which we presume to be offerings left by Indians. This line of sites, in and along the Sjovold creek valley is what we would expect to find if there were once trails along the rims of the creek leading to a river crossing at the Sjovold site.

As to the Sjovold site, itself, there is some evidence which may link it to a river crossing, but all of it is circumstantial. For example, one interesting feature of the site is an overwhelming predominance of bison bones among the faunal remains. It is quite evident that other game such as deer, elk, bear, fish and perhaps even moose, were nearly ignored. The dominance of bison throughout the long series of occupations could be an indicator for a high degree of transiency by occupants who either did not want or would not take time to exploit the wider array of game available within the valley. This is what might be expected in a river crossing campsite.

The only local resources which were exploited consistently and extensively through all occupations were coarse rocks used for boiling or steaming foods and, of course, the water required for those same processes. Considerable quantities of such rock were found in almost every layer. There was spotty use of other valley resources such as quartzites, andesites, and petrified peat for chipped stone tools. Yet, overall, the archaeological remains reflect a fairly meagre exploitation of a fairly rich environment. This narrow range of local resource exploitation seems grossly insufficient as a primary explanation for repeated occupation of this site. However, it fits very well with the remains one might expect to find in a transitory river crossing campsite.

The tendency for Sjovold occupations to be short term fair weather events is another possible indicator. Indians who were seeking a pleasant campsite could have used this locality at any time of the year, but its greatest value as a river crossing would have been during warm weather when good river crossings were much harder to find.

There is no conclusive evidence for construction of watercraft within the site. However, tools which could have been useful for such manufacture are present. These include endscrapers for cleaning and thinning hides, flake knives for cutting rawhide boat covers or ropes, or for cutting sinews used as threads. There is also a stone axe which could have been used for cutting trees.

In conclusion, the evidence of landscape suitability, historical observations and archaeological remains all support an interpretation of the Sjovold locality as a preferred river crossing. The principal landscape requirements for such a crossing appear to have been good approaches on both sides of the river, nearly uniform river depth, and good camping places at the landings. We have shown that the Sjovold locality meets these requirements, and that both historical observations and archaeological remains may be used as evidence for its sporadic use as a river crossing over the past 4000 years. This gives the Sjovold site a place within ancient travel networks which is rare for the northern Plains. Future identification of other river crossings should be of considerable assistance in reconstructing the trails and movements of ancient northern Plains peoples.

Future Research

Several issues arising out of Sjovold investigations could benefit from additional research. Some of these might be resolved by more excavations at the site, others by additional archaeological explorations and multidisciplinary study in the locality, yet others belong in a broader field of study.

One of the issues which could be resolved by enlarged excavations is the accuracy of our perception that use of the site diminished after about AD 1350. Careful excavation of the surface sod and buried deposits to the level of Layer II in an area near our excavations would throw additional light on this question as would a more thorough surface survey and near surface testing program of habitable areas adjoining the site on both sides of the creek. It would be particularly interesting to know if the ridge on the south side of the creek, opposite the one bearing the Sjovold site, has been used as an alternative river crossing campsite.

Another question, which would require a substantial research commitment, is determination of the archaeological identity of occupation layers we were unable to identify (IV-V, VIII, IX, XIII, XV, XVI and XVII). This would involve excavation of an area at least the size of our excavations, preferably adjoining or nearby so that correlations with our information would be strong. Such a program would substantially enlarge the samples of features and artifacts we recovered and would enrich our understanding of all layers. As an adjunct to such a program, or as smaller stand-alone project, it would be interesting to test the recovery methods we employed against the enhanced recovery of water screening and flotation methods. One kind of recovery we would particularly like to enlarge on is wood charcoal from hearths, however, there are many other kinds of micro-remains — chipping debris, small tools and ornaments, small bones and bone fragments, snail shells, to name a few — which could enhance our knowledge of the site.

Some of the occupation layers raise important typological questions for future research. For example, what is the significance of corner-notching versus side-notching? It appears that our traditional practice of ascribing all corner-notched points to an entity called Pelican Lake can no longer be sustained. Corner-notched points are extremely abundant in the northern Plains. Since they are considered to be diagnostic Pelican Lake artifacts, the current inventory of "known components" in the South Saskatchewan River Valley suggests that Pelican Lake is second in abundance only to the Besant series (Table 2.3). However, the same inventory contains only three excavated Pelican Lake components (Table 2.3), and only two of these have been directly dated (Table 2.4). This problem calls for a variety of studies to explore the typological and technological variability of corner-notched points, the potential for defining several types of such points, and a review of the spatial and temporal distributions of the types.

A matter which came up during our analysis was identification of residues adhering to stone tools. We were unable to achieve positive identifications for what we believe to be blood residues on many tools. Moreover, we did not make thorough observations for other residues adhering to tools, and were unable to make any positive identifications, except for particles of charcoal. Several methods are now available, or under development, for identification of such residues. The stunning interpretive advances that would be possible as a result of such identifications — what materials the tools were used on, how they were used, what species of animals were killed or butchered by certain tools — make this an alluring field of study. Sjovold tools already recovered could be profitably studied by such methods.

Another matter which came up during our analysis was the anomalous distribution of clam shells. We noted that they do not appear below Layer IX. Is this a cultural phenomenon? Our knowledge of the native use of freshwater clams in the northern Plains is poor, and the subject deserves some research.

Our interpretation of the Sjovold site as a river crossing raises the possibility that there are alternative crossings in the wide valley zone of the river. If the Sjovold crossing was of the type preferred by pedestrians seeking dry passage as we have postulated, then why was it used only twenty odd times during the past 4000 years? The answer may lie in the existence of alternative crossing places within the zone. We have learned that agricultural pioneers used at least two other temporary crossings within several kilometers of the Sjovold site. Aboriginal people may have done the same. An archaeological reconnaissance of all potential river crossings within this "broad valley" zone is needed to test the idea. Important indicators would be the presence of campsite debris at suitable habitation sites on both sides of each suspected crossing.

Another matter requiring further reconnaissance is the location of chippable stone sources in the CSBR. We have some indication that surface coarse rock sources adjoining the site may have supplied materials such as andesite and quartzite. We suspect that a source for one of the most important finer chipping materials in the site, petrified peat, may have been eroded river edge deposits nearby. A concentration of petrified peat slabs has been observed in a borrow pit opposite Outlook. Whether this is the source of Sjovold material and whether there are other better sources are open questions.

It would also be interesting to explore the potential avenues of approach to the Sjovold crossing, roughly parallel and perpendicular to the river on both sides. This might reveal a pattern in site location that could be interpreted as being associated with trails. The valley and rim of Sjovold Creek, along which approach trails may have passed from the west, is an interesting geographical feature in its own right with a fairly high potential for containing a variety of camp, bison kill, sacred and ceremonial sites.

A final issue of somewhat broader concern is the date, about 4500 years ago, at which the ridge containing the Sjovold site began to accumulate. We suspect that the change in geological process may be a reflection of a broad environmental change in the northern Plains. The date corresponds, approximately, to the end of a warm dry period, the Atlantic period, and the commencement of the somewhat cooler and moister Sub-Boreal climatic period (cf. Wendland 1978:280; Dyck 1983:88). Recent studies indicate that effects of that climatic change followed different schedules in different parts of Western Canada (e.g., Zoltai and Vitt 1990). However, the coincidences we are noticing occur in different parts of the prairies at approximately the same time. One example is that all multicomponent sites on the Kenney Terrace of the Oldman River Valley, a tributary of the South Saskatchewan River in southwest Alberta, begin with the McKean/Duncan/Hanna Series, usually Hanna (Van Dyke 1994). This suggests that the Kenney Terrace became habitable at approximately the same time as the Sjovold ridge. Meanwhile, at Chappice Lake in southeastern Alberta, reductions in salinity of lake sediments begin about 4400 years ago and signal a period of rising water levels (Vance, et al. 1992). At about 4300 years ago, cooler moister climate is reflected in pollen-bearing lake sediments from the ecotonal parkland/forest zone of east-central Saskatchewan by a shift from parkland to forest (Burley 1982:22; Wilson 1982). These coincidences suggest to us that environmental changes at the beginning of the Sub-Boreal may have been somewhat more profound and more nearly synchronous across the northern Plains than is presently thought.

Appendix A

Levels, Layers and Catalogue Numbers

During excavations we removed the artifact-bearing deposits in 88 successive vertical provenience units to which we gave the field name "layers." At first we attempted to make the excavated "layers" conform in plane and thickness to the contours of natural and occupation layers which we could see in adjoining test profiles. For example, we labelled all materials from what we thought was occupation layer 1 as "Layer 1," all from the interlayer between layers 1 and 2 as "between layers 1 and 2" and all from layer 2 as "Layer 2." It was soon apparent, however, that exact matches between target layers and excavation layers were difficult to achieve in some places. In such cases, even with test profiles to guide us, we were not perfectly confident that our excavated "layer" conformed to the intended natural or cultural layer. Often, it was only after we had completed excavation of a particular occupation layer and could see its wall profile that we could assess how close our match had been. Even then, parts of some layers remained difficult to assess until more deposits had been removed and more wall profile was exposed.

In order to cope with this uncertainty we reduced the thickness of excavation layers wherever we had reason to doubt the conformity to an occupation or natural layer we were trying to uncover. Thinner excavation layers gave us the option for subsequent reallocation of smaller provenience units to a better association, if subsequent analysis indicated that was desirable. This same method worked to our advantage when occupation debris in a particular layer was too concentrated to expose easily in one excavation layer.

Following excavations, as we began detailed laboratory analysis of the cultural stratigraphy, one of our first tasks was to rename all field-labelled "layer" proveniences with a numerical sequence of excavation "levels." This freed the term "layer" for use in reference to occupation layers and interlayers, each of which might comprise several excavation levels. The correlations among artifact catalogue numbers, field excavation layers, laboratory excavation levels, and final occupation layers and interlayers are shown in Table A.1. Each catalogue number range bears the prefix "P" for piece-plotted items or "S" for items recovered by screening. Underlined numbers mark items from disturbed areas that have been excluded from the analysis.

Table A.1. Assignments of excavation levels and catalogue entries to analytical layers at the Sjovold site[a].

Layer	Level	Field description	XU6: 2s4w	XU5: 2s2w	XU4: 2s0w	XU3: 0s4w	XU2: 0s2w	XU1: 0s0w
1	1-1	Above Layer 1	S1932-1976, 8060-8065	S1922-1931	S1909-1921	-	-	S386-393,415-417
1	1-2	LAYER 1	S1996-2002	S1990-1995	S1978-1989, 8066	S410-414	S400-409	S394-399, 8041
1/2	1-3	Betw. L1 & L2	S2022-2025	S2013-2021	S2003-2012	-	-	-
2	2-1	LAYER 2	S2052-2058	S2039-2051	S2026-2038	S433,462-474	S431-432, 443-446,460-461, 8069-8070	S418-430, 8067-8068
2	2-1	LAYER 2	-	-	-	P447-455,8042, 8072	P441,456-459, 8071	P434-440,442
2	2-1	LAYER 2	-	-	-	-	-	S475-479
2/3	2-2	Betw. L2 & L3a	-	-	-	S486-488	S489-496,8074	S480-485,8073
3	3-2	LAYER 3a	-	-	-	S542-551, 8086-8087	S520-541, 8084-8085	S504-519,8043
3	3-2	LAYER 3a	-	-	-	-	P552-553	P8081-8083
3	3-1	Below L2 & L3	S2162-2232	S2088-2161, 8075-8079	S2059-2087	-	-	S497-503,554-560
3	3-3	LAYER 3b	-	-	-	S585-593,8089	S570-584	S561-569
3	3-3	LAYER 3b	-	-	-	P653-703	P596-652,8088	P594-595,8050
3	3-4	Below L3b,incl.L3c	-	-	-	S733-755	S719-732	S704-718,8090
3	3-5	LAYER 3c	-	-	-	P799-834,8093	P757-798,8044, 8092	P756,8091
3	3-5	LAYER 3c	-	-	-	-	S835-856	-
3/4	3-6	Betw. L3c & L4	-	-	-	S870-882	S864-869	S857-863
4+5	4-1	LAYER 4	-	-	-	S895-904	S888-894,8094	S883-887
4+5	4-1	LAYER 4	-	-	-	P914-918,8046	P906-913,8045	P905
4+5	4-2	Betw. L4 & L5	-	-	-	-	-	S919-922
4+5	4-2	Betw. L4 & L5	-	-	-	S934-937	S926-933	S923-925
4+5	4-3	LAYERS 4 & 5	S2308-2346	S2274-2307	S2233-2273	-	-	-
4+5	5-1	LAYER 5	-	-	-	-	S938-939	-
4+5	5-1	LAYER 5	-	-	-	P945-948	P941-944	P940
5/6	5-2	Betw. L5 & L6	-	-	-	-	S966-976	S949-965
6	6-2	LAYER 6a	-	-	-	S983-992	S980-982	S977-979

Table A.1 (continued).

Layer	Level	Field description	XU6: 2s4w	XU5: 2s2w	XU4: 2s0w	XU3: 0s4w	XU2: 0s2w	XU1: 0s0w
6	6-2	LAYER 6a	-	-	-	P997-999,1001-1009,8105-8107	P1000,8100-8104	P993-996, 8098-8099
6	6-3	Below L6a	-	-	-	S1031-1041	S1021-1030	S1010-1020
6	6-4	LAYER 6b	-	-	-	P1074-1081, 8120-8121	P1060-1073, 8110-8119	P1042-1059, 8108-8109
6	6-1	LAYER 6	S2485-2533	S2438-2484, 8096-8097	S2347-2437	S8047	-	-
6	6-5	Below L6b	-	-	-	-	S1101-1113	S1082-1100
6	6-6	LAYER 6c	-	-	-	-	P1130-1149	P1123-1129
6/7	6-5	Below L6b	-	-	-	S1114-1122	-	-
6/7	6-7	Below L6c	-	-	-	-	S1187-1207	S1170-1186
6/7	7-2	Above L7a	-	-	-	-	S1227-1234	S1223-1226
7	6-6	LAYER 6c	-	-	-	PP1150-1169	-	-
7	6-7	Below L6c	-	-	-	S1208-1222	-	-
7	7-1	LAYER 7	S2699-2780	S2624-2698	S2534-2623	-	-	-
7	7-3	LAYER 7a	-	-	-	-	P1261-1280, 8122-8128	P1243-1260
7	7-4	Below L7a	-	-	-	-	-	S1299-1312
7	7-5	LAYER 7b	-	-	-	-	-	P1345-1367, 8133-8145
7	7-5	LAYER 7b	-	-	-	-	-	S1432-1436
7/8	7-2	Above L7a	-	-	-	S1235-1242	-	-
7/8	7-4	Below L7a	-	-	-	-	S1313-1332	-
7/8	8-1	Above L8, 0-4 cm	-	-	-	-	-	S1450-1473
8	7-3	LAYER 7a	-	-	-	P1281-1298, 8129-8132	-	-
8	7-5	LAYER 7b	-	-	-	-	P1368-1402, 8146-8150	-
8	8-2	LAYER 8	-	-	-	-	-	P1498-1522
8/9	7-4	Below L7a	-	-	-	S1333-1344	-	-
8/9	8-1	Above L8, 0-4 cm	-	-	-	-	S1437-49,1474-84	-
8/9	8-3	Below L8, 0-6 cm	-	-	-	-	-	S1626-1656
9	7-5	LAYER 7b	-	-	-	P1403-1431, 8151-8154	-	-

Table A.1 (continued).

Layer	Level	Field description	XU6: 2s4w	XU5: 2s2w	XU4: 2s0w	XU3: 0s4w	XU2: 0s2w	XU1: 0s0w
9	8-1	Above L8, 0-4 cm	-	-	-	S1485-1497	-	-
9	8-2	LAYER 8	-	-	-	P1545-1624	P1523-1544	-
9	8-3	Below L8, 0-6 cm	-	-	-	S1694-1703	S1657-1693	-
8-10	8-4	LAYERS 8 & 9	S3145-3232	S2936-3144	S2781-2935	-	-	-
9	9-1	LAYER 9	-	-	-	P1738-1761	P1717-1737	P1704-1716
9	9-2	Below L9, 0-6 cm	-	-	-	S1800-1822	S1784-1799	S1762-1783
10	9-3	Below L9, top of L10	-	-	-	S1985-1908	S1866-1894	S1823-1865
10	10-1	Top of L10a	-	-	-	S3394-3409	S3307-3325	S3233-3246
10	10-2	LAYER 10a	-	-	-	P3410-3480	P3306,3326-3393, 8048	P3247-3305, 8049
10	10-3	Below L10a, 0-3 cm	-	-	-	S3534-3550, 3620-3690	S3515-3533, 3578-3619	S3481-3514, 3551-3577
10	10-4	Immed. above L10b	S3868-3951	S3785-3867	S3741-3784	S3713-3740	S3700-3712	S3691-3699
10	10-5	LAYER 10b	P4059-4082	P4042-4058	P4027-4041	P3990-4026	P3971-3989	P3952-3970
10	10-5	LAYER 10b	S4293-4297	S4270-4292	-	S4231-4245	-	S4083-4153
10	10-6	Below L10b, 0-3 cm	-	-	S4246-4269	-	S4154-4230	-
10	10-7	Below L10b	-	S4427-4435	S4416-4426	S4380-4415	S4343-4379	S4323-4342
11	10-6	Below L10b, 0-3 cm	S4298-4322	-	-	-	-	-
11	10-7	Below L10b	S4436-4465	-	-	-	-	-
11	11-1	Immed. above L11	S4773-4806	S4721-4772	S4673-4720	S4614-4672	S4560-4613	S4466-4559
11	11-2	LAYER 11	P5027-5040	P4983-5026	P4878-4982	P4861-4877	P4845-4860	P4807-4844
11	11-2	LAYER 11	S5179-5183	S5148-5178, 5283-5302	S5100-5147	S5060-5099	S5072-5079	S5041-5071
11	11-3	Below L11, 0-4 cm	-	-	S5241-5282	-	-	S5184-5240
11/12	11-4	Below L11	S5360-5368	S5339-5355	S5303-5338	-	-	S5609-5620
12	12-1	Above L12, 0-4 cm	S5372-5377	S5369-5371	S5356-5359, 5449-5466	-	-	-
12	12-2	LAYER 12	P5429-5437	P5415-5428	P5379-5414	-	-	P5378,5621-5625
12	12-2	LAYER 12	S5447-5448	S5443-5446	S5438-5442	-	-	S5626-5636
12	12-3	L12 bottom	-	-	-	-	-	P6003-6004
12	12-4	Below L12, 0-5 cm	S5530-5539	S5477-5491, 5501-5529	S5467-5476, 5492-5500	-	-	S5981-6002
						End of excavation in XUs 1-3		
12/13	12-5	5-18 cm below L12	S5546-5557, 5607	S5540-5545, 5603-5605	-			

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Table A.1 (continued).

Layer	Level	Field description	XU6: 2s4w	XU5: 2s2w	XU4: 2s0w	XU3: 0s4w	XU2: 0s2w	XU1: 0s0w
12/13	12-6	18-30 cm below L12	S5591-5599, 5608	S5580-5590, 5606	S5558-5579, 5600-5602			
13	13-1	LAYER 13	P5688-5725	P5669-5687	P5637-5668			
13	13-1	LAYER 13	S5798-5817, 5840-5849	S5726-5797, 5829-5839	S5818-5828			
13	13-2	Below L13, 0-4 cm	S5900-5980	S5875-5899	S5850-5874, 6005-6079			
13	13-3	Betw. L13 & L14a	-	-	P6122-6167			
13/14	13-3	Betw. L13 & L14a	-	S6080-6121	-			
13/14	14-1	LAYER 14a	-	-	S6196-6202			
14	14-1	LAYER 14a	P6175-6195, 8155	P6168-6174	-			
14	14-1	LAYER 14a	S6210-6232, 6263-6435	S6203-6209, 6821	S6233-6262			
14	14-2	Below L14a, 0-2 cm	S6466-6480	-	S6436-6465			
14	14-3	Below L14a, 2-6 cm	S6508-6514	S6489-6507	S6481-6488			
14	14-4	LAYER 14b	P6621-6656	P6579-6620	P6516-6578			
14	14-4	LAYER 14b	S6671-6674	S6663-6670, 6809-6813	S6657-6662, 6765-6808, 6814-6816			
14	14-5	Below L14b, 265-270	-	S6722-6728	S6817-6820			
14/15	14-6	Below L14b, 270-275	-	S6822-6844	S6675-6699			
14/15	14-7	Below L14b, 275-280	S6757-6764	S6729-6751	S6700-6719			
14/15	14-8	Below L14b, 280-290	S6845-6846	S6752-6756	S6720-6721			
15	15-1	Above L15	S6845-6846, 6852-6856	S6851	S6847-6850			
15	15-2	LAYER 15	P6877-6897	P6865-6874, 6876	P6857-6864,6909			
15	15-2	LAYER 15	S6903-6908	S6902	S6898-6901			
15	15-3	Immed. below L15	S6919-6926	S6916-6918	S6910-6915			
15/16	(Nothing recovered)							
16	16-1	Above L16	-	S6928	S6927			
16	16-2	Top of L16	S6931-6932	S6930	S6929			

Table A.1 (continued).

Layer	Level	Field description	XU6: 2s4w	XU5: 2s2w	XU4: 2s0w	XU3: 0s4w	XU2: 0s2w	XU1: 0s0w
16	16-3	LAYER 16	P6955-6961	P6875,6938-6954	P6933-6937			
16/17	16-4	Betw. L16 & L17	S6981-6989, 6990	S6970-6980	S6962-6969			
17	17-1	LAYER 17	P7032-7054	P7010-7031	P6992-7009			
17	17-1	LAYER 17	S7067-7068	S7060-7066	S7055-7059			
17	17-2	Below L17, 0-2 cm	S7094-7110	S7074-7093	S7069-7073			
18	18-1	LAYER 18	P7117-7118	P7116	P7111-7115			
18/19	(Nothing recovered)							
19	19-1	LAYER 19a	P7177-7182	P7161-7176	P7119-7160			
19	19-1	LAYER 19a	S7187-7188	S7184-7186, 7189-7244	S7183			
19	19-2	Below L19a	S7281-7283	S7271-7280, 7284-7335	S7245-7270			
19	19-3	LAYER 19b	P7501-7509	P7438-7500	P7336-7437			
19	19-3	LAYER 19b	-	S7723-7733	-			
19	19-4	Above L19c	S7522-7524	S7710-7722	S7510-7521			
19	19-5	LAYER 19c	P7681-7709	P7568-7680	P7525-7567			
19	19-6	Below L19c	S7752-7756	S7744-7751	S7734-7743			
19	19-7	LAYER 19d	P7785	P7782-7784	P7757-7781			
19	19-8	Below L19d	S7797-7798	S7793-7796	S7786-7792			
19	19-9	LAYER 19e	-	-	S7799-7810			
20	20-1	LAYER 20	P7855-7858	P7831-7854	P7811-7830			
20	20-1	LAYER 20	S7862	S7860-7861, 7864-7867	S7859			
20/21	20-2	Below L20	S7884-7885	S7881-7883	S7863,7868-7880			
21	21-1	LAYER 21a	P7944-7952	P7911-7943	P7886-7910			
21	21-1	LAYER 21a	-	-	S7974-7977			
21	21-2	Below L21a	S7973	S7961-7972	S7953-7960			
21	21-3	LAYER 21b	P8029-8036	P7989-8028	P7978-7988			
21	21-4	Below L21b	-	S8037-8040	-			

a. Prefix "P" marks piece-plotted items; "S" represents screen recovery; underlined numbers are from disturbed areas excluded from analysis.

Appendix B

Bison Age and Gender Analysis

This appendix contains measurements and non-metric observations concerning the age-at-death and gender of bison from the Sjovold site. The data are assembled here in support of the site interpretations offered in the main text as well as future comparative analyses of other bison assemblages. Anatomical elements that contribute to this study are arranged in the sequence seen elsewhere in this volume: head region, axial region, fore limb, and hind limb. All measurements are in centimeters. Measurements expressed to the nearest 0.1 cm are taken on an osteometric board or else are estimates (E) that allow for slight damage at the measurement points. Measurements expressed to the nearest 0.01 cm are taken with dial calipers graduated to 0.005 cm. The expression "nm" means "not measurable."

Throughout this study we have mentioned calf (©), cow or calf (♀/©), cow (♀), and bull (♂) age/gender categories, but these rather vague assignments vary in meaning from one anatomical part to another. This appendix clarifies some of these distinctions by collating data on the age at epiphyseal fusion in *Bison bonasus* (Empel and Roskosz 1963). Lacking evidence to the contrary we assume that *B. bison* follows a similar fusion schedule. In some limb bones, the age at fusion of proximal and distal epiphyses differs by several years. In such cases, measurements on the last-fusing end permit distinctions between adult cows (♀) and adult bulls (♂), whereas the opposite end of the bone can support assignments only to a mixed group of cows and calves (♀/©) versus bulls (♂).

The length of shaft attached to articular ends is one of several approaches to the comparative analysis of long bone fragmentation explored by Todd and Rapson (1988). This approach seeks to provide an approximation of where along its shaft a bone has been broken by measuring the length of the resulting fragment. Since bones that differ in age and gender may also differ in length, it is necessary to standardize the fragment length measurement by some other measurement — usually the breadth of the articular end — taken from the same bone. The resulting index is termed the "shaft ratio" (Todd and Rapson 1988: Fig. 7). If the standardizing measurement cannot be made on a given specimen, we use the mean value of that measurement for the gender as determined at Sjovold. Although not obviously related to the analysis of age and gender, we suggest that bones of bulls and cows may, in some seasons of the year, have been selected for different purposes such as marrow retrieval or bone grease manufacture. Such distinctions would be blurred in a multicomponent site such as Sjovold, but we present both fragment length and shaft ratio in the tables of long bone measurements as an aid to future comparative analysis.

As mentioned in the text, several methods of gender analysis have been proposed and tested.

The most elegant, and probably most reliable, are methods employing discriminant functions that operate on several measurements at a time. In some cases, several discriminant function equations aid in the gender assignment of a given element. Walde's (1985, 1994) analysis of measurements presented by Speth (1983) yielded equations for the proximal and distal ends of all six long bones. Walde's method of discriminant function analysis provides paired equations for male and female. Measurements of an unknown specimen are entered into each equation in a pair with the results being subtracted, female from male. If the difference is positive the specimen is classified as a bull; a negative difference classifies the bone as cow (or cow/calf, depending on considerations of epiphyseal fusion). If the absolute value of the difference is less than 1.6 — an arbitrary rejection value recommended by Walde (1985:27) — no decision is made. For elements with multiple pairs of equations the results may not always be in agreement in which case no decision is made. We summarize all of these variables with a simple fractional statement of the form "DFAx/y" where x signifies the number of discriminant function analyses (DFAs) that yield the stated result and y indicates the total number of DFAs that can be performed on the measurements provided by the specimen. If no DFAs can be used due to missing measurements, we resort to simpler methods of gender assignment, such as bivariate plots and inspection of overall ranges.

Given our reliance on Walde's (1985, 1994) work, we have followed Speth's (1983) measurement instructions very carefully. In addition we have recorded measurements described by Todd (1987a), especially when they were needed to calculate shaft ratios. We have made extensive but selective use of the measurements published by Speth (1983). Morlan has examined all of the bison skeletons measured by Speth at the U.S. National Museum of Natural History (Smithsonian Institution, Washington, D.C.). As a result, we have omitted four subadults (N022668, N154570, N251147, N534060) and two Wood Bison (N172689, N249894) listed by Speth.

Maxilla, Mandible. The study of tooth eruption and wear patterns is discussed in the main text (see Chapter 5). It is hampered by small sample sizes and especially by the absence of complete tooth rows. In many cases it has been necessary to reconstruct partial tooth rows from isolated teeth, and it is seldom possible to determine the position of the tooth enamel base in relation to the alveolar opening. Nonetheless, agreement between tooth height and descriptive criteria suggest that the Sjovold teeth have been placed in a reliable series of relative age groups (Tables B.1, B.2). In addition, five of the mandibles furnish measurements that support gender assignments using criteria published by Reher (1974), Shackleton, et al. (1975), and Todd and Hofman (1987).

Atlas. Only two of the three atlas vertebrae are complete enough to furnish reliable measurements, and both appear to represent cows or calves (Table B.3).

Scapula. Of 11 scapulae preserving some portion of the glenoid fossa (Table 5.9), only six can be measured for gender analysis (Table B.4). A seventh specimen lacks the glenoid epiphysis that fuses during the first year of life (Empel and Roskosz 1963:265). The ♀/◐ category may include two- and three-year old male calves that are not distinguishable from adult cows.

Table B.1. Measurements and observations on bison maxillary molars.[a]

Group	Layer[b]	Teeth	Paracone Height			Entostyle Wear[c]			Cusp Definition[d]			Facet Wear[e]		
			M^1	M^2	M^3	M^1	M^2	M^3	M^1	M^2	M^3	M^1	M^2	M^3
A	XIV	dP^4	-	-	-	-	-	-	-	-	-	-	-	-
B	VIII-X	dP^3-M^2	4.78	E6.3	-	0	?	-	5	5	-	7	1	-
B	Profile 3	dP^4-M^1	4.77	-	-	0	-	-	5	-	-	7	-	-
B?	XI	M^2	-	nm	-	-	?	-	-	5	-	-	0?	-
B?	XIV	M^2	-	nm	-	-	0	-	-	?	-	-	0?	-
C?	XIX	M^2	-	nm	-	-	0	-	-	5	-	-	6	-
C	VI	dP^3	-	-	-	-	-	-	-	-	-	-	-	-
C	X	dP^3-M^2, P^{2-4}	4.38	6.43	-	1	0	0	5	5	-	8	7	-
C	X	dP^3-M^1, P^{2-4}	4.51	-	-	1	-	-	5	-	-	8	-	-
3-4	XII/XIII	P^2-M^1	3.28	-	-	2	-	-	4	-	-	8	-	-
3-4	XIII	M^1	E2.7	-	-	3	-	-	3	-	-	8	-	-
3-4	Profile 2	P^2-M^2	3.44	5.34	-	3	0	-	4	5	-	8	8	-
4?	XIX	M^2	-	E4.9	-	-	2	-	-	5	-	-	8	-
4-5	XII	M^{2-3}	-	5.34	5.36	-	0	0	-	5	5	-	8	7
4-5	Profile 3	P^3-M^3	3.18	5.05	5.55	3	0	0	4	5	5	8	8	8
5?	XIX	M^{2-3}	-	4.22	E4.6	-	2	0	-	5	5	-	8	8
4-6	XIV	M^{2-3}	-	E4.2	E4.7	-	1	0	-	3	3	-	8	7
4-6	XIV	M^{2-3}	-	E4.5	4.97	-	0	0	-	3	4	-	8	7
6	X	P^3-M^2	2.18	3.73	-	3	2	-	3	4	-	8	8	-
6	X	P^2-M^1	nm	-	-	3	-	-	3	-	-	8	-	-
6	XII	M^{1-3}	E2.6	4.04	4.69	3	2	2	3	4	5	8	8	8
6	VI	M^1	2.16	-	-	3	-	-	3	-	-	8	-	-
7	III	P^3-M^2	1.48	nm	-	3	3	-	3	3	-	8	8	-
7	XIV	M^1	nm	-	-	3	-	-	2	-	-	8	-	-
10-11	XII,XII/XIII	M^{1-3}	nm	1.63	nm	4	4	3	1	2	3	8	8	8

a. Lettered groups are described in the text; other groups are numbered with reference to Wilson's (1980) description of the Garnsey site bison. b. Profile 2 and Profile 3 indicate specimens from test profile positions that cannot be correlated with site stratigraphy. c. 0, no wear; 1, polished; 2, worn as separate circle; 3, worn and joined to occlusal surface; 4, obscured by wear. d. 1, cupped; 2, flat; 3, weakly bilophodont; 4, moderately bilophodont; 5, strongly bilophodont. e. facet wear stages as in Reher and Frison (1980:65).

Table B.2. Measurements and observations on bison mandibular molars.[a]

			Metaconid Height			Exostylid Wear[d]			Cusp Definition[e]			Facet Wear[f]		
Group	Layer[b]	Teeth/Gender[c]	M_1	M_2	M_3	M_1	M_2	M_3	M_1	M_2	M_3	M_1	M_2	M_3
B	X	$M_{2\text{-}3}$	-	E5.9	bud	-	0	0	-	5	5	-	2	0
B	XIV	$M_{1\text{-}2}$	E4.6	nm	-	1	0	-	5	5	-	8	3	-
B	XIII	M_2	-	nm	-	-	?	-	-	5	-	-	4	-
B	XXI	$M_{1\text{-}2}$	4.60	nm	-	0	0	-	5	5	-	8	3	-
C	X	M_2	-	6.16	-	-	0	-	-	5	-	-	7	-
C	X	P_2-M_3, dP_4	4.09	E6.2	nm	1	0	?	5	5	5	8	7	?
4?	III	$M_{2\text{-}3}$	-	E4.9	E5.8	-	0	0	-	5	5	-	8	3
4?	VIII-X	M_2	-	5.77	-	-	0	-	-	5	-	-	8	-
4?	XIII	M_2	-	5.12	-	-	0	-	-	5	-	-	8	-
5	IX	M_3	-	-	5.39	-	-	0	-	-	5	-	-	9
5?	XII	M_3	-	-	E5.8	-	-	0	-	-	5	-	-	9
5	XIII	M_3	-	-	nm	-	-	0	-	-	5	-	-	9
6?	XI	P_3-M_3/♂	2.05	3.76	4.50	3	2	0	5	5	5	8	8	10
6?	XIV	$M_{2\text{-}3}$	-	4.05	E5.1	-	2	0	-	5	5	-	8	10
6-7	XII/XIII	M_1	E1.9	-	-	3	-	-	3	-	-	8	-	-
8	II	$M_{2\text{-}3}$/♀	-	3.14	nm	-	3	2	-	4	5	-	8	10
8	XI	P_2-M_3/♀	1.32	2.69	3.87	3	2	2	3	4	5	8	8	10
10	X	M_3	-	-	2.82	-	-	3	-	-	5	-	-	10
10-11	XVI/XVII	P_3-M_3/♀	0.00	1.64	2.09	5	3	3	1	3	3	8	8	10
10-11	XIX	$M_{1\text{-}3}$/♂	0.00	1.98	2.45	5	3	3	1	3	3	8	8	10
12	Profile 3	$M_{1\text{-}3}$	0.00	0.00	2.17	5	5	3	0	1	3	8	8	10

a. Lettered groups are described in the text; other groups are numbered with reference to Wilson's (1980) description of the Garnsey site bison. b. Profile 3 indicates a specimen from a test profile position that cannot be correlated with site stratigraphy. c. Gender based on criteria in Todd and Hofman (1987), Reher (1974), and Shackleton, et al. (1975). d. 0, no wear; 1, polished; 2, worn as separate circle; 3, worn and joined to occlusal surface; 4, obscured by wear; 5, worn away. e. 0, worn to roots; 1, cupped; 2, flat; 3, weakly bilophodont; 4, moderately bilophodont; 5, strongly bilophodont. f. facet wear stages as in Reher and Frison (1980:65).

Table B.3. Measurements of bison atlas vertebrae.[a]

Layer	Catno	GB	GL	BFcr	BFcd	GLF	H	Gender[b]
XI	4991	19.2	12.5	11.55	11.40	9.97	10.6	♀/⊙
XII	5433	nm	11.0	11.90	10.99	9.46	8.5	♀/⊙

a. See von den Driesch (1976) for definitions and illustrations of measurements: GB, greatest breadth; GL, greatest length; BFcr, breadth of cranial articular surface; BFcd, breadth of caudal articular surface; GLF, length from cranial to caudal articular surface; H, height. b. Gender assignments based on comparisons with measurements in Speth and Parry (1978, 1980).

Table B.4. Measurements of bison scapulae.[a]

Layer	Catno	GLP	LG	BG	SLC	Gender[b]
XIX	7530	7.89	6.19	4.82	nm	♀/⊙
XXI	7886	7.79	6.51	4.91	nm	♀/⊙
XVI	6933	7.41	6.05	5.02	5.77	♀/⊙
XIV	6596	6.60	6.33	5.24	nm	♀/⊙
XI	4888	9.29	8.00	6.30	nm	♂
VII	2585	9.38	7.72	6.37	E8.0	♂
Mean, ♀/⊙		7.42	6.27	5.00	5.77	
Mean, ♂		9.34	7.86	6.34	8.0	

a. See von den Driesch (1976) for definitions and illustrations of measurements: GLP, greatest length of glenoid process; LG, length of glenoid cavity; BG, breadth of glenoid cavity; SLC, smallest length of neck. b. All gender assignments based on bimodality observed in bivariate plots.

Humerus. All preserved humerus epiphyses are completely fused, but two shaft cylinders and two shaft fragments exhibit the porous bone surfaces seen in very young calves. Various sources give different ages for distal epiphysis fusion in *Bison bonasus*. Koch (1935:372) places it at the beginning of the fourth year of life and states that the epicondyles fuse immediately thereafter. Duffield (1973: Table 1) misquotes Koch by stating that the proximal end of the humerus fuses shortly after the distal end (his table also lists the head of the humerus as fusing in the sixth year). We suspect that Empel and Roskosz (1963:266-267) are correct that the distal trochlea fuses to the diaphysis in the second year and that the epicondylar epiphyses are fused in animals more than 3-4 years old. Measurements of distal humerus fragments must be used with caution in gender assignments, because one cannot determine whether the proximal epiphysis has fused. Therefore male calves could be mistaken for adult cows (see Todd 1987b:163-164). However, adult bulls can be separated from a mixed group of adult cows and calves. One well preserved humerus from Layer XIV yields mixed DFA results with one pair of equations indicating bull, another indicating cow or calf, and two yielding no decision; it is probably a sub-adult bull (Table B.5).

Table B.5. Measurements of bison distal humerus fragments.

					Measurements[a]					Frag.	Shaft	Gender
Layer	Catno	SpI	SpJ	SpK	SpM	SpN	SpO	To11	To14	Length	Ratio[b]	Basis[c]
					Cow or Calf (♀/⦶)							
VI	8102	7.83	4.96	nm	7.53	E3.4	E4.5	nm	3.85	9.4	1.20	DFA5/5
X	4046	8.26	5.17	8.13	nm	E3.4	E4.4	9.05	4.02	7.3	0.88	DFA6/6
XII/XIII	5601	8.07	5.26	7.93	7.23	3.91	4.78	9.09	4.02	20.2	2.50	DFA6/9
XIV	6586	8.27	5.39	E7.9	7.58	E3.5	4.37	E8.7	4.16	11.0	1.33	DFA8/9
II	8072	7.92	5.40	7.99	6.96	E3.4	4.47	9.23	4.05	11.7	1.48	DFA8/9
XII/XIII	5607	E8.4	5.55	8.45	8.19	E3.3	E4.6	9.54	4.15	23.2	2.76	DFA6/9
XI	4892	7.93	5.56	8.26	7.40	3.58	4.36	8.97	4.04	11.9	1.50	DFA8/9
XIX	7731	nm	5.23	nm	nm	nm	nm	nm	nm	5.5	0.68	DFA1/1
					Gender unassigned							
XIV	6587	8.41	5.27	8.42	7.83	3.94	5.11	9.78	4.27	17.2	2.05	DFA9/9
					Bull (♂)							
VII	2699	9.00	5.94	9.60	E7.8	nm	nm	10.65	4.39	15.4	1.71	DFA3/4
XVI	6944	9.70	6.12	10.04	8.94	3.96	5.62	10.48	4.42	21.0	2.16	DFA9/9
VI	8120	nm	nm	nm	nm	nm	nm	nm	4.52	6.7	0.72	To14
Mean, ♀/⦶		8.10	5.32	8.11	7.48	3.50	4.50	9.10	4.04	12.5	1.55	
Mean, ♂		9.35	6.03	9.82	8.37	3.96	5.62	10.57	4.44	14.4	1.54	

a. Sp = Speth (1983), To = Todd (1987a), for definitions and illustrations of the measurements: SpI (=To7), Greatest breadth of distal condyle; SpJ, Medial length of trochlea; SpK, Diagonal depth of medial epicondyle; SpM, Proximal breadth of distal condyle; SpN, Length of capitulum; SpO, Length of lateral epicondyle; To11, Greatest depth of distal end; To14, Least depth of distal end; b. Shaft Ratio = Frag. length/SpI (Todd and Rapson 1988:317). c. DFA, Discriminant Function Analysis (Walde 1985, 1994; Brink, et al. 1986:194).

Table B.6. Measurements of bison proximal radius fragments.

Layer	Catno	SpA	SpB	Measurements[a] SpC	SpD	To4	Frag. Length	Shaft Ratio[b]	Gender Basis[c]
				Cow or Calf (♀/⊖)					
XI	4458	7.5	E3.9	E2.2	nm	7.43	6.4	0.86	DFA4/4
X	4381	8.1	E4.1	2.81	4.78	7.94	8.6	1.08	DFA6/6
XIX	7474	7.9	4.22	2.77	4.80	7.57	9.8	1.29	DFA6/6
XIII	5958	8.5	4.31	2.73	4.92	8.00	10.6	1.33	DFA6/6
XIX	7568	8.6	4.45	2.19	5.33	8.16	11.5	1.41	DFA6/6
XIV	6809	8.6	4.48	2.86	4.68	7.96	11.0	1.38	DFA6/6
VII	8123	8.6	4.48	E2.2	5.54	8.16	10.6	1.30	DFA6/6
XIX	7503	8.8	4.64	2.93	5.38	8.40	12.3	1.46	DFA6/6
XIV	6809	8.7	4.66	2.78	5.45	8.30	15.5	1.87	DFA6/6
XIX	7464	8.7	4.69	3.22	5.44	8.35	12.1	1.45	DFA3/6
XIV	6531	nm	4.41	nm	nm	nm	12.8	1.61	SpB
XIV/XV	6739	E7.3	4.06	E2.1	E4.6	E7.3	23.6	3.23	DFA6/6
					Bull (♂)				
XI	4818	9.6	5.07	3.58	E5.3	8.97	18.9	2.11	DFA6/6
VI	8103	nm	nm	3.70	nm	nm	8.3	0.92	SpC
XIII	5639	nm	4.75	nm	nm	nm	11.5	1.28	SpB
Mean, ♀/⊖		8.30	4.37	2.62	5.09	7.96	12.07	1.52	
Mean, ♂		9.60	4.91	3.64	5.30	8.97	12.90	1.44	

a. Sp = Speth (1983), To = Todd (1987a), for definitions and illustrations of the measurements: SPa (=To3), Greatest breadth of proximal end; SpB (=To9), Greatest depth of proximal end; SpC (=To10), Depth of capitular articular surface; SpD, Breadth between lateral and medial ulnar facets; To4, Greatest breadth of proximal articular surface. b. Shaft Ratio = Frag. length/To4 (Todd and Rapson 1988:317). c. DFA, Discriminant Function Analysis (Walde 1985, 1994).

Table B.7. Measurements of bison distal radioulna fragments.

Layer	Catno	SpG	SpH	SpI	SpJ	SpK	To8	To11	Frag. Length	Shaft Ratio[b]	Gender Basis[c]
				Measurements[a]							
Cow (♀)											
X	3344	7.6	4.12	3.73	1.60	2.27	7.27	4.6	6.9	0.91	DFA4/4
XVI	6938	7.8	4.24	4.15	1.61	2.48	7.50	5.5	12.4	1.59	DFA4/4
Subadult bull											
X	4045	9.0	4.83	4.80	2.17	2.95	8.83	5.8	12.5	1.39	Fusion
Bull (♂)											
VII	8133	9.1	4.73	5.10	1.88	3.33	8.87	6.0	11.0	1.21	DFA4/4
XIV	6469	9.9	6.13	5.10	2.37	3.47	9.48	6.4	24.9	2.52	DFA4/4
X	4163	nm	5.05	4.99	2.19	nm	nm	nm	5.0	0.53	SpHIJ
Mean, ♀		7.70	4.18	3.94	1.61	2.38	7.39	5.05	9.7	1.26	
Mean, ♂		9.50	5.30	5.06	2.15	3.40	9.18	6.20	13.6	1.43	

a. Sp = Speth (1983), To = Todd (1987a), for definitions and illustrations of the measurements: SpG (=To7), Greatest breadth of distal end; SpH, Medial length of distal epiphysis; SpI, Greatest diagonal breadth of radial and intermediate carpal articular surfaces; SpJ, Minimum breadth of radial carpal facet; SpK (=To12), Greatest breadth of radial carpal facet; To8, Greatest breadth of distal articular surface; To11, Greatest depth of distal end. b. Shaft Ratio = Frag. length/SpG (Todd and Rapson 1988:317). c. DFA, Discriminant Function Analysis (Walde 1985, 1994).

Radius. One proximal radius lacks its epiphysis, and there are at least four distal ends, including the complete radius, with unfused epiphyses. Todd (1987b:172) notes discrepancies between Koch (1935) and Empel and Roskosz (1963) concerning fusion of the proximal radius in *Bison bonasus*, and his analysis supports the conclusions of Empel and Roskosz (1963:270): the proximal epiphysis is completely fused in the second year of life, whereas fusion of the distal end occurs in the fifth year in bulls and the sixth year in cows. Four unfused distal specimens have well ossified shafts, but an unfused proximal end and a shaft cylinder missing both ends have porous surfaces. Except for the complete radius in Layer XIV, known by its unfused distal end to be a calf, it is not possible to separate adult cows from 3-4 year olds of both sexes using proximal end measurements (Table B.6). For example, catno 7464 represents a cow, according to three pairs of DFA equations, but three other pairs yield marginal results with values of less than 1.6; the specimen may actually belong to a subadult bull. One distal radius from Layer X (catno 4045) is probably a bull in its fifth year of life, because its unfused epiphysis remained loosely attached the shaft until removed from the bag for study (Table B.7); one pair of DFA equations classified it as a bull, the second pair as a cow, and the third pair yielded no decision.

Carpals. Length, width, and depth measurements described elsewhere (Morlan 1991), for all but the accessory carpal, permit recognition of adult bulls and a mixed group of cows and calves (Table B.8). Since the carpal bones lack epiphyses, it is not possible to infer skeletal maturity that would separate cows from calves. Gender assignments have been made by inspection of bivariate plots and comparison with measurements of documented modern bison carpals curated at the Smithsonian Institution, Illinois State Museum, University of Saskatchewan, and Provincial Museum of Alberta. In most cases where there are multiple carpals from one side in a given excavation level, the carpal measurements are in agreement as to gender and indicate that all the bones may represent a single carpal assembly (e.g. Layer X). In a few cases (e.g. Layer XIV) both bull and cow/calf sizes are present, and it is commonplace to find too few carpals to make up a complete carpal assembly. Since no cut marks have been observed on the carpals or on the adjacent distal radius and proximal metacarpal, it is difficult to understand why so many carpals are missing from the site. One possibility is that scavenging carnivores consumed whole carpal bones or have reduced them to unrecognizable fragments, but carnivore tooth marks are also rare on adjacent elements and have not been observed on the surviving carpals.

Metacarpal. All of the proximal epiphyses are fused, but two distal fragments from Layer VII have unfused epiphyses and porous shaft surfaces. The distal metacarpal epiphysis fuses in the third year of life in *Bison bonasus* (Empel and Roskosz 1963:273), but the porous surfaces of the Sjovold specimens suggest a much younger age. Measurements of the proximal ends identify two bull, three cow or calf, and one unassigned specimen (Table B.9). The unassigned specimen is interesting because it is a complete metacarpal with a fused distal epiphysis and distal measurements that show it to be an adult bull (Table B.10). Walde (1985) reports similar problems in assigning gender to bison metacarpals.

Table B.8. Measurements of bison carpal bones.[a]

Layer	Catno	Length	Width	Depth	Gender
		Radial carpal			
XXI	7967	3.22	2.27	E4.1	♀/◐
XVI	6941	2.86	2.63	4.40	♀/◐
VII	8136	3.30	3.14	5.18	♂
X	4166	3.47	3.21	5.26	♂
Mean, ♀/◐		3.04	2.45	4.25	
Mean, ♂		3.39	3.18	5.22	
		Intermediate carpal			
XVI	6942	2.77	3.29	4.19	♀/◐
XXI	7993	2.75	2.84	4.24	♀/◐
XIV	6585	2.69	3.15	4.32	♀/◐
VII	2586	2.95	3.39	4.97	♂
X	3573	3.03	3.51	4.99	♂
X	4167	3.18	3.98	5.07	♂
X	3266	2.87	3.61	5.16	♂
VI	8104	3.07	3.67	5.19	♂
Mean, ♀/◐		2.74	3.09	4.25	
Mean, ♂		3.02	3.63	5.08	
		Ulnar carpal[b]			
XXI	7968	2.98	2.36	3.42	♀/◐
XI	5617	3.07	2.43	3.67	♀/◐
XVI	6940	3.11	2.52	3.71	♀/◐
I	395	2.95	2.38	3.89	♀/◐
X	3367	3.25	E3.1	nm	♀/◐
X	3966	3.61	2.97	4.24	♂
X	4168	3.49	2.86	4.39	♂
XIV	6604	3.82	3.03	4.68	♂
Mean, ♀/◐		3.03	2.42	3.67	
Mean, ♂		3.64	2.95	4.44	
		Carpal 2+3			
XVI	6875	1.74	3.73	3.07	♀/◐
XVI	6939	1.75	3.91	3.27	♀/◐
XXI	7965	1.59	3.51	3.45	♀/◐
III	2062	2.12	3.71	3.56	♀/◐
I	1967	2.15	3.82	3.57	♀/◐
XII/XIII	5557	2.37	3.93	3.76	♀/◐
VII	8135	2.53	4.55	3.98	♂
X	4156	2.10	4.96	4.11	♂
Mean, ♀/◐		1.95	3.77	3.45	
Mean, ♂		2.32	4.76	4.05	

Table B.8 (continued).

Layer	Catno	Length	Width	Depth	Gender
			Carpal 4		
XVI	6943	2.44	2.85	3.25	♀/⦶
I	1981	2.59	2.95	3.29	♀/⦶
XVII	6996	2.59	3.11	3.41	♀/⦶
XI	4593	2.47	2.92	3.74	♀/⦶
X	3250	2.80	3.11	3.75	♀/⦶
XI	4824	2.57	3.15	3.80	♀/⦶
XXI	7993	2.44	2.53	nm	♀/⦶
XIX	7178	2.86	3.55	3.92	♂
X	4034	2.71	3.40	4.14	♂
XIV	6649	2.77	3.71	4.16	♂
Mean, ♀/⦶		2.51	2.87	3.42	
Mean, ♂		2.74	3.38	3.95	

a. See Morlan (1991) for descriptions and illustrations of the measurements. b. Only anterior length is given for the ulnar carpal.

Table B.9. Measurements of bison proximal metacarpal fragments.

		Measurements[a]			Frag.	Shaft	Gender
Layer	Catno	SpA	SpB	SpC	Length	Ratio[b]	Basis[c]
			Cow or Calf (♀/⦶)				
VI	8106	6.06	3.65	3.83	10.7	1.77	DFA3/3
XIV	6169	6.33	3.78	3.81	6.0	0.95	DFA3/3
XIV	6821	6.74	4.02	4.07	8.9	1.32	DFA3/3
			Gender unassigned				
XII/XIII	5552	6.83	4.14	4.15	19.4	2.84	DFA3/3
			Bull (♂)				
VII	2587	7.64	4.35	4.62	10.2	1.34	DFA3/3
X	4162[d]	7.87	4.60	4.85	6.7	0.85	DFA3/3
Mean, ♀/⦶		6.38	3.82	3.90	8.5	1.33	
Mean, ♂		7.76	4.48	4.74	8.5	1.09	

a. Sp = Speth (1983), for definitions and illustrations of the measurements: SpA, Greatest breadth of proximal end; SpB, Greatest depth of proximal end; SpC, greatest breadth of carpal 2+3 facet. b. Shaft ratio = Frag. length/SpA. c. DFA, Discriminant Function Analysis (Walde 1985, 1994). d. Three conjoined fragments numbered 4162, 4175, and 4184.

Table B.10. Measurements of bison distal metacarpal fragments.

		Measurements[a]							Frag.	Shaft	Gender
Layer	Catno	SpD	SpE	SpF	SpG	SpH	SpI	SpJ	Length	Ratio[b]	Basis[c]
						Cow (♀)					
XXI	7911	6.49	3.28	3.09	2.68	2.41	3.53	3.41	10.2	1.57	DFA3/4
XXI	8007	nm	nm	2.84	nm	2.54	nm	3.46	4.9	0.76	SpFHJ
						Bull (♂)					
XII/XIII	5552	6.86	3.57	3.32	2.96	2.59	3.77	3.53	19.4	2.83	DFA4/4
VI	2488[d]	E7.4	3.40	3.40	2.69	2.88	3.55	3.52	20.1	2.72	DFA4/4
XIV/XV	6686	E7.6	4.10	3.76	nm	2.98	E4.2	4.10	8.9	1.17	DFA4/4
IV-V	2294	E7.6	3.85	nm	3.18	nm	4.14	nm	10.5	1.38	SpDEGI
XVII	7013	nm	E4.0	nm	nm	nm	nm	nm	8.9	1.21	SpE
Mean, ♀		6.49	3.28	2.97	2.68	2.48	3.53	3.44	7.6	1.17	
Mean, ♂		7.37	3.73	3.49	2.94	2.82	3.92	3.72	13.6	1.85	

a. Sp = Speth (1983), for definitions and illustrations of the measurements: SpD, Greatest breadth of distal end, at fusion line; SpE, Breadth of medial condyle; SpF, Breadth of lateral condyle; SpG, Depth of medial trochlea; SpH, depth of lateral trochlea; SpI, Depth of medial sagittal ridge; SpJ, Depth of lateral sagittal ridge. b. Shaft Ratio = Frag. length/SpD. c. DFA, Discriminant Function Analysis (Walde 1985, 1994). d. Three conjoined fragments numbered 2488, 2490, and 2492.

Front phalanges. The proximal epiphysis fuses on both the first and second phalanges, both manus and pes, by the beginning of the second year of life in *Bison bonasus* (Empel and Roskosz 1963:274, 284). An unassigned first phalanx (Layer VII), and two unassigned second phalanges (Layers VI, XII/XIII) have unfused proximal epiphyses. All of the recognizable front phalanges have fully fused epiphyses.

Duffield (1973) reports sexual dimorphism in the first and second phalanges of *Bison bonasus* based on measurements published by Empel and Roskosz (1963) who used an index of proximal width divided by length. Duffield (1973:136) modifies this approach by plotting the index against distal width. Roberts (1982:30) reports that Duffield "ignored the fact that Empel and Roskosz used only individuals aged 5+ years in their demonstration," and she notes that this age criterion cannot be applied to most archaeological samples. Roberts (1982:31) finds that Duffield's method "is unsuccessful in sexing North American bison aged 3 years and older." Her alternative is a discriminant function equation that defines the boundary between adult males and females.

Duffield's method sorts the front first phalanges from the Sjovold site into two clusters that we interpret to represent mature bulls and a mixed group of cows and calves (Table B.11). We refer to the smaller sized cluster as a cow/calf group despite the fused epiphyses, because some of these small animals may not have reached skeletal maturity in other anatomical elements. Roberts' discriminant function achieves the same results but differs from Duffield's method by assigning one specimen to the opposite group and by failing to assign gender to three specimens with missing data (Table B.11). One bull can be tentatively identified on the basis of proximal width only.

Discriminant functions are not yet available for other phalanges, and Duffield's method does not produce a clearly bimodal distribution in front second phalanges from the Sjovold site. Either this element lacks strong sexual dimorphism in *Bison bison* or the Sjovold phalanges are so dominated by adult bulls that a second mode representing smaller cows and calves is not apparent. Most of the third phalanges are fragmentary and cannot be assigned to manus and pes. Therefore we have not measured them.

Femur. A wide range of age groups is reflected by the femur fragments, but they cannot be precisely specified. All femoral epiphyses fuse in the fifth year of life in *Bison bonasus* (Empel and Roskosz 1963:277), and fragments of one proximal (Layer X) and two distal (Layers VIII-X, XIII) epiphyses must represent animals younger than this. In addition, two shaft fragments (Layers XII, XX) are judged to represent large but immature animals on the basis of size. Even younger (juvenile) animals are represented by a shaft fragment from Layer XIII and a nearly complete femur from Layer VIII, and a fetus is represented by a shaft cylinder in Layer VI.

Table B.11. Measurements of bison front first phalanges.

		Measurements[a]							
Layer	Catno	PL	GL	Wp	Wd	Dd	Gender[b]	Index[c]	Gender[d]
XXI	7902	6.25	6.50	3.29	E3.2	E2.2	♀/⊖	52.6	♀/⊖
XXI	7957	6.24	6.42	3.39	3.21	2.38	♀/⊖	54.3	♀/⊖
XIV	6390	6.15	6.35	3.37	3.24	2.45	♀/⊖	54.8	♀/⊖
XII/XIII	5556	5.93	E6.2	3.65	3.52	E2.6	♀/⊖	61.6	♂
XII	5621	E6.6	6.96	4.09	E3.6	E2.4	♂	62.3	♂
III	2215	6.52	7.10	3.87	3.69	2.92	♂	59.4	♂
VIII	1509	6.58	6.89	3.80	3.87	2.81	♂	57.8	♂
XIV	6644	E6.9	7.14	3.84	3.88	nm	-	56.0	♂
XIV	6628	E6.8	nm	3.77	3.98	nm	-	55.6	♂
VII	8127	E6.3	nm	E3.7	3.98	2.80	-	58.4	♂
XXI	7937	nm	nm	3.79	nm	nm	-	nm	-
Mean, ♀/⊖		6.12	6.42	3.35	3.22	2.34		54.7	
Mean, ♂		6.62	7.02	3.85	3.83	2.73		58.2	

a. See von den Driesch (1976), Duffield (1973), and Roberts (1982) for definitions and illustrations of measurements: PL, Peripheral length; GL, Greatest length; Wp, Proximal width; Wd, Distal width: Dd, Distal depth. b. Gender based on discriminant function analysis, requiring PL, GL, and Dd (Roberts 1982). c. Index = Wp/PL X 100. d. Gender based on index (Duffield 1973).

Table B.12. Measurements of bison distal tibia fragments.

		Measurements[a]			Frag.	Shaft	Gender
Layer	Catno	SpH	SpI	SpJ	Length	Ratio[b]	Basis[c]
				Calf (⊙)			
I	1979	E6.1	4.7	4.33	-	-	No fusion
VII	8122	6.6	E4.8	5.09	19.6	2.97	No fusion
XI	4697	E5.9	E4.1	4.96	12.0	2.03	No fusion
				Cow or Calf (♀/⊙)			
XIX	7358	E6.1	nm	4.80	8.7	1.43	DFA2/2
XIV	6174	6.4	4.7	4.64	9.6	1.50	DFA3/3
XI	4831	6.2	4.7	4.74	11.8	1.90	DFA3/3
XI	4816	6.3	4.8	4.61	38.1	6.05	DFA3/3
XXI	7989	6.4	4.8	4.65	11.3	1.77	DFA3/3
X	4161	6.7	4.8	4.88	13.7	2.04	DFA3/3
XI	4833	6.4	4.9	4.75	8.7	1.36	DFA3/3
				Gender unassigned			
XIX	7466	7.0	5.0	5.16	19.0	2.71	DFA3/3
XII	5514	7.1	5.0	5.14	16.2	2.28	DFA3/3
				Bull (♂)			
XIV	6780	6.9	4.8	5.28	10.6	1.54	DFA2/3
XIV	6172	6.9	5.3	5.34	22.5	3.26	DFA2/3
XXI	7945	7.4	5.3	5.14	22.7	3.07	DFA3/3
X	4008	7.0	5.4	5.25	16.2	2.31	DFA2/3
VII	2624	7.4	5.6	5.13	19.9	2.69	DFA3/3
Mean, ♀/⊙		6.36	4.78	4.72	14.6	2.30	
Mean, ♂		7.12	5.28	5.23	18.4	2.58	

a. Sp = Speth (1983), To = Todd (1987a), for definitions and illustrations of the measurements: SpH (=To7), Greatest breadth of distal end; SpI (=To10), Greatest depth of distal end; SpJ (=To14), Greatest breadth of articular grooves. b. Shaft ratio = Frag. length/SpH. c. DFA, Discriminant Function Analysis (Walde 1985, 1994; Brink, et al. 1986:194).

The femora are so fragmentary that very few specimens can be measured to determine gender. Even the complete femur from Layer XI is damaged locally so as to preclude complete mensural data, but it is judged to be an adult cow from the few measurements that can be taken. One distal femur (Layer XXI) and two proximal femora (Layers II, XI) are judged to be adult bulls on the basis of a few measurements, but the data are too incomplete to warrant a detailed listing.

Tibia. In *Bison bonasus*, the tibial tuberosity at the proximal end of the anterior crest fuses to the proximal epiphysis after the third year of life, and the proximal epiphysis fuses to the shaft in the sixth year (Empel and Roskosz 1963:279). Both of these fusions have occurred throughout the small sample of proximal tibiae from the Sjovold site. Only two proximal tibiae can be measured for determination of gender. One is the complete tibia from Layer XI, a cow, and the other is a proximal tibia with attached shaft from Layer IX, also a cow on the basis of Walde's (1985, 1994) discriminant function equations.

Table B.13. Measurements of the bison calcaneus.

Layer	Catno	Wd	Dd	Measurements[a] Lt	Lc	Wp	Dp	Gender
X	4155	4.08	5.71	2.90	3.80	E2.7	E3.7	⊖
III	8082	nm	5.72	3.22	3.85	3.56	3.77	⊖
III	8081	4.09	5.81	3.11	3.91	nm	nm	♀/⊖
III	735	4.03	5.50	3.01	3.70	3.41	3.65	♀
X	4131	4.10	5.62	3.18	3.79	3.60	E3.4	♀
III	2213	4.15	5.62	3.15	3.78	3.38	3.84	♀
X	3992	4.78	E5.8	nm	4.51	nm	nm	♂
VI	8110	nm	5.86	3.26	4.12	nm	nm	♂
XI	4823	4.58	6.19	3.58	4.38	nm	nm	♂
XIX	7682	4.53	6.34	3.48	4.20	nm	nm	♂
X	4154	4.48	6.84	3.57	4.54	4.27	4.56	♂
Mean, ♀		4.09	5.58	3.11	3.76	3.46	3.63	
Mean, ♂		4.59	6.20	3.47	4.35	4.27	4.56	

a. See Morlan (1991) for descriptions and illustrations of the measurements: Wd, distal width; Dd, distal depth; Lt, length of talus facet; Lc, length of tarsal C+4 facet; Wp, proximal width; Dp, proximal depth.

Table B.14. Measurements of the bison talus.

Layer	Catno	Ll	Lm	Measurements[a] Wp	Wd	Dl	Dm	Gender
I	1909	6.74	6.19	4.41	4.29	3.70	3.74	♀/⊖
XIII	5792	7.24	6.98	4.80	4.46	4.13	nm	♀/⊖
XI	4886	7.09	6.49	E4.4	4.48	3.77	3.55	♀/⊖
X	4159	7.16	6.73	5.05	4.71	3.84	3.45	♀/⊖
VIII	8147	7.79	7.27	5.70	5.05	4.61	4.15	♂
IV-V	2295	nm	7.32	nm	5.09	E4.3	3.99	♂
X	4158	8.16	7.71	5.51	5.24	4.53	4.01	♂
X	4004	8.08	7.44	5.51	5.37	4.40	3.86	♂
Mean, ♀/⊖		7.06	6.60	4.67	4.49	3.86	3.58	
Mean, ♂		8.01	7.44	5.57	5.19	4.46	4.00	

a. See Morlan (1991) for descriptions and illustrations of the measurements: Ll, lateral length; Lm, medial length; Wp, proximal width; Wd, distal width; Dl, lateral depth; Dm, medial depth.

Table B.15. Measurements of bison tarsal C+4, tarsal 2+3, and lateral malleolus.[a]

Layer	Catno	Length	Width	Depth	Gender
		Tarsal C+4			
IX	1716	3.95	5.76	5.15	♀/●
XI	4882	3.97	5.51	5.40	♀/●
III	8083	4.29	5.85	5.69	♀/●
XII	5497	4.51	5.85	5.72	♀/●
X	4157	4.64	5.59	5.80	♀/●
XIX	7683	5.07	6.37	6.17	♂
XI	5233	5.04	6.38	6.18	♂
X	3993	5.25	6.49	6.19	♂
X	4156	4.89	6.32	6.25	♂
VIII-X	2913	4.68	6.57	6.33	♂
XIV	6601	5.13	6.70	6.44	♂
Mean, ♀/●		4.27	5.71	5.55	
Mean, ♂		5.01	6.47	6.26	
		Tarsal 2+3			
XI	5276	0.98	2.38	3.52	♀/●
I	1980	1.05	2.19	3.60	♀/●
III	2219	1.14	2.45	3.71	♀/●
X	4172	1.13	2.45	3.82	♀/●
XI	5237	1.12	2.52	3.83	♀/●
X	3998	1.25	2.65	4.24	♂
X	4169	1.36	2.75	4.26	♂
XIX	7684	1.35	2.82	4.33	♂
XIV	6592	1.27	2.85	4.46	♂
Mean, ♀/●		1.08	2.40	3.70	
Mean, ♂		1.31	2.77	4.32	
		Lateral malleolus			
XIV	6394	2.42	1.58	3.46	♀/●
VII/VIII	1235	E2.5	E1.5	E3.6	♀/●
XIX	7434	2.53	1.70	3.41	♀/●
I	387	2.62	1.47	3.13	♀/●
XI	5064	2.65	1.51	3.54	♀/●
X	4171	2.67	1.73	3.41	♀/●
XI	5063	2.71	1.53	3.62	♀/●
XII	5518	2.66	E1.6	3.83	♀/●
X	4002	2.95	1.88	3.95	♂
XII	5426	2.98	2.05	3.92	♂
XX/XXI	7781	3.01	2.22	3.98	♂
VII	2640	E3.1	1.86	4.47	♂
Mean, ♀/●		2.61	1.58	3.50	
Mean, ♂		3.01	2.00	4.08	

[a] See Morlan (1991) for descriptions and illustrations of the measurements.

Table B.16. Measurements of bison proximal metatarsal fragments.

		Measurements[a]			Frag.	Shaft	Gender
Layer	Catno	SpA	SpB	SpC	Length	Ratio[b]	Basis[c]
			Cow or Calf (♀/◉)				
I	1978	4.41	4.50	2.28	15.8	3.58	DFA1/1
X	4160	5.03	4.80	2.63	10.2	2.03	DFA1/1
			Bull (♂)				
X	4173[d]	5.80	5.33	nm	8.3	1.41	DFA1/1
XIX	7681	5.74	5.41	3.03	17.9	3.12	DFA1/1
Mean, ♀/◉		4.72	4.65	2.46	13.0	2.75	
Mean, ♂		5.77	5.37	3.03	13.1	2.27	

a. Sp = Speth (1983), for definitions and illustrations of the measurements: SpA, Greatest breadth of proximal end; SpB, Greatest depth of proximal end; SpC, Greatest breadth of tarsal 2+3 facet. b. Shaft Ratio = Frag. length/SpA. c. DFA, Discriminant Function Analysis (Walde 1985, 1994). d. Three conjoined fragments numbered 4173, 4174, and 4189.

The distal epiphysis of the tibia is fused without a trace in *Bison bonasus* individuals older than three years (Empel and Roskosz 1963:279). Three Sjovold tibiae have unfused distal epiphyses, showing that they represent calves less than three years old. In addition there are 14 distal tibiae that can be measured for determination of gender (Table B.12). Walde (1985, 1994) generated two pairs of discriminant function equations, and a third pair was produced by Brink, et al. (1986:194). Since it is not possible to determine the proximal fusion state for most of these specimens, small individuals could represent either nearly mature calves (>3 years old) or adult cows.

Calcaneus. Among the tarsal bones, only the calcaneus has an epiphysis that aids in separating calves from adults. Its fusion on the tuber calcis occurs in the fifth year in bulls and the sixth year in cows of *Bison bonasus* (Empel and Roskosz 1963:282). In the Sjovold site, two specimens have unfused epiphyses, four have fused epiphyses, and five are broken so as to preclude assessment. Bivariate plots of distal width against distal depth, and tarsal C+4 facet length against talus facet length, are in agreement as to gender assignments for the Sjovold calcanei (Table B.13).

Other tarsals. Measurements described elsewhere (Morlan 1991, for all but tarsal 1 permit distinctions between adult bulls and a mixed group of cows and calves. Unfortunately, discriminant functions are not yet available for this analysis. Of the six measurements taken on the talus, complete data are available only for medial length and distal width (Table B.14). Other elements of the tarsal assembly are measured merely for length, width and depth (Table B.15). Bivariate plots of width against depth separate bulls from cows and calves for tarsal C+4 and tarsal 2+3. Length against depth provides a moderately good separation of these groups for the lateral malleolus.

Table B.17. Measurements of bison distal metatarsal fragments.

		Measurements[a]							Frag.	Shaft	Gender
Layer	Catno	SpD	SpE	SpF	SpG	SpH	SpI	SpJ	Length	Ratio[b]	Basis[c]
Calf (°)											
XXI	7987	5.86	2.76	2.54	2.63	2.28	3.56	3.38	10.2	1.74	No fusion
XXI	8014	nm	3.34	nm	2.64	nm	3.47	nm	-	-	No fusion
Cow (♀)											
XI	4459	5.57	2.51	2.42	2.44	2.24	3.28	3.23	8.4	1.51	DFA3/3
XI	4592	5.49	2.58	2.40	2.38	2.11	3.33	3.12	7.6	1.38	DFA3/3
X	4035	nm	2.69	2.28	2.35	E2.1	3.31	E2.9	3.2	0.56	DFA1/1
X	4380	5.44	2.77	2.41	2.43	2.00	3.04	3.01	6.3	1.16	DFA3/3
XXI	8021	5.96	2.76	2.75	2.68	2.50	3.63	3.47	8.6	1.44	DFA3/3
III	8093	5.93	2.92	2.65	2.74	2.39	3.67	E3.4	9.8	1.65	DFA2/3
III	8092	6.05	2.92	2.82	2.62	2.35	E3.4	E3.4	7.8	1.29	DFA2/3
XIV	6470	nm	3.02	nm	2.75	nm	3.60	nm	11.9	2.07	SpGI
Gender unassigned											
XII	5515	nm	3.10	2.94	2.50	nm	3.33	3.44	4.6	-	DFA1/1
X	3271	nm	3.00	2.78	nm	nm	nm	nm	3.9	-	-
Bull (♂)											
XI	4871	6.28	3.12	2.89	2.87	2.50	3.80	3.50	10.3	1.64	DFA3/3
Mean, ♀		5.74	2.77	2.53	2.55	2.24	3.41	3.22	8.0	1.39	
Mean, ♂		6.28	3.12	2.89	2.87	2.50	3.80	3.50	10.3	1.64	

a. Sp = Speth (1983), for definitions and illustrations of the measurements: SpD, Greatest breadth of distal end, at fusion line; SpE, Breadth of medial condyle; SpF, Breadth of lateral condyle; SpG, depth of medial trochlea; SpH, depth of lateral trochlea; SpI, Depth of medial sagittal ridge; SpJ, Depth of lateral sagittal ridge. b. Shaft Ratio = Frag. length/SpD. c. DFA, Discriminant Function Analysis (Walde 1985, 1994).

Table B.18. Measurements of bison hind first phalanges.

Layer	Catno	PL	Measurements[a] Wp	Wd	Index	Gender
XI	4650	6.28	E2.6	2.69	41.6	♀/◐
XII/XIII	5603	6.28	E2.8	2.98	44.7	♀/◐
X	4372	6.26	2.89	2.90	46.2	♀/◐
X	3440	6.87	E3.3	3.28	47.5	♂
X	3989	6.94	3.41	3.21	49.1	♂
X	3609	E6.6	3.10	E2.9	50.0	♂
XII	5496	6.69	3.38	3.48	50.5	♂
XI	4808	6.70	3.40	2.99	50.7	♂
XI	4858	6.87	E3.5	E3.5	51.1	♂
VI	8105	6.40	3.30	3.38	51.6	♂
X	3298	6.29	3.26	3.14	51.8	♂
X	4048	nm	3.10	E3.0	-	♂?
VI	8108	nm	E3.3	nm	-	♂?
XXI	7937	nm	3.41	nm	-	♂?
XXI	7978	nm	3.52	nm	-	♂?
VII	8128	nm	nm	3.64	-	♂?
Mean, ♀/◐		6.27	2.76	2.86	44.0	
Mean, ♂		6.63	3.33	3.24	50.2	

a. See von den Driesch (1976) for definitions and illustrations of measurements: PL, peripheral length; Wp, proximal width; Wd, distal width; Index = Wp/PL X 100.

Relatively complete tarsal assemblies are present in Layers X, XI, and XIX. As in the case of the carpal assembly, however, it is interesting that so many isolated tarsals and incomplete assemblies appear in various levels of the Sjovold site. Since only one cut mark — on the tuber calcis of a calcaneus — is present, it is unlikely that tarsals are missing as a result of butchering practices. Carnivore gnawing is evident on one talus (Layer VIII), two calcanei (Layers III, XI), and one lateral malleolus (Layer XXI). Perhaps some tarsals were ingested or carried away by carnivores.

Metatarsal. All of the proximal epiphyses are fused, but one proximal end with shaft (Layer I) has a porous surface texture indicative of relative immaturity (see Table B.16). One distal end was recovered from Layer XXI along with its unfused epiphyses, and an isolated lateral condyle epiphysis was found in the same layer (see also Table B.17). This epiphysis fuses in the third year of life in *Bison bonasus* (Empel and Roskosz 1963:283).

Hind phalanges. The proximal epiphysis fuses on both the first and second phalanges, both manus and pes, by the beginning of the second year of life in *Bison bonasus* (Empel and Roskosz 1963:274, 284). All of the hind first and second phalanges have fully fused epiphyses. Roberts' (1982) discriminant function analysis was developed for the first front phalanges and cannot be used for other elements. We used bivariate plots of several measurement pairs for hind first phalanges. These reveal that the best separation of bull from cow/calf is achieved by plotting proximal depth against a width/length index (Table B.18). Four bulls are tentatively identified on the basis of proximal width alone, and a fifth bull provides the largest distal width measurement.

Of four hind second phalanges, one has an unfused proximal epiphysis, and the other three reveal no bimodality. Given the predominance of bulls among the hind first phalanges, it seems likely that the three measureable hind second phalanges represent adult bulls. They are similar in size to an adult bull reference specimen (NMC-75120). Only two hind third phalanges have been recognized in the Sjovold site, and there are probably others among the unassigned third phalanges. Therefore we have not measured them.

Appendix C

Abbreviations and Codes

Introduction

Our uses of data base management software during the analysis of the Sjovold site encouraged the encoding of data so as to minimize storage requirements and to facilitate data manipulation. Our analytical data bases were developed in Open Access II, a software package from Software Products International, Inc., San Diego, California. This package integrates word processing, data base and spreadsheet functions and provides both statistical and graphics capabilities. The data bases support versatile retrieval commands using Structured Query Language (SQL).

Copies of our coding protocols are on file at both the Canadian Museum of Civilization and the Royal Saskatchewan Museum, and we will not enlarge this report by reproducing them here in their entirety. However, some of the codes are employed in this report in tabular and graphic presentations, and these are listed here as an aid to the reader.

Coarse Rock Types

AMP	amphibolite
AND	andesite
ANR	anorthrosite
BAS	basalt
BCL	baked clay
CHR	chert, including agate, Swan River Chert and others
CON	concretion
DIA	diabase
DIO	diorite
DOL	dolomite
GAB	gabbro
G-N	granitic-gneiss or grano-gneiss
GNI	gneiss
GRA	granite, including some small angular pieces of biotite and feldspar
GWK	greywacke
LIM	limestone
MSH	mica schist
MUD	mudstone
PER	peridotite
PYR	pyroxene
QPR	quartz porphyry
QTE	quartzite
QTZ	quartz
RYO	rhyolite
SCH	schist
SHA	shale
SLA	slate
SND	sandstone
SSD	silicified sediment
SYN	syenite
TUF	tuff
UNID	unidentified

Stone Tool Types

ABR	Abrader
ANV	Anvil
AXE	Axe
BIF	Biface knife
CHM	Chipping hammer
CHI	Chitho
CHP	Chopper
CSC	Concave scraper
ESC	End scraper
HAM	Hammerstone
MURL	Marginally utilized or retouched lithic
PRF	Perforator
PPT	Projectile point
PFM	Projectile point preform
SCR	Large scraper
WDG	Wedge

Chipped Stone Types

AGT	agate
AMP	amphibolite
AND	andesite
BAS	basalt
CHL	chalcedony
CHR	chert
FSH	fused shale
GST	Gronlid Siltstone
JAS	jasper
KRF	Knife River Flint
LIM	limestone
MISC	miscellaneous
OBS	obsidian (OBS)
PPT	petrified peat
PWD	petrified wood
QPR	quartz porphyry
QTE	quartzite
QTZ	quartz
SND	sandstone
SSD	silicified sediment
SRC	Swan River Chert
UN	unidentified

Mammal Bones

ATL	Atlas
AXI	Axis
AXL	Axial, rib or vertebral spine
BAC	Baculum
C	Canine, upper or lower
C1	Carpal 1 (trapezium)
C2	Carpal 2 (trapezoid)
C23	Carpal 2+3 (magnum)
C3	Carpal 3 (capitate)
C4	Carpal 4 (unciform or hamate)
C5	Carpal 5 (hamulus)
CAL	Calcaneus
CAR	Carpal
CAU	Caudal
CER	Cervical
CLV	Clavicle
COS	Costal cartilage
CRA	Cranium
CTH	Cheektooth
CUB	Cuboid
DC	Deciduous canine, upper or lower
DI	Deciduous incisor, upper or lower
DLC	Deciduous lower canine
DLI0	Deciduous lower incisor
DLI1	Deciduous lower 1st incisor
DLI2	Deciduous lower 2nd incisor
DLI3	Deciduous lower 3rd incisor
DLP0	Deciduous lower premolar
DLP1	Deciduous lower 1st premolar
DLP2	Deciduous lower 2nd premolar
DLP3	Deciduous lower 3rd premolar
DLP4	Deciduous lower 4th premolar
DP	Deciduous premolar
DSS	Distal sesamoid
DUC	Deciduous upper canine

DUI0	Deciduous upper incisor
DUI1	Deciduous upper 1st incisor
DUI2	Deciduous upper 2nd incisor
DUI3	Deciduous upper 3rd incisor
DUP0	Deciduous upper premolar
DUP1	Deciduous upper 1st premolar
DUP2	Deciduous upper 2nd premolar
DUP3	Deciduous upper 3rd premolar
DUP4	Deciduous upper 4th premolar
ETH	Ethmoid
FAC	Facial
FEM	Femur
FIB	Fibula (lateral malleolus)
FP1	Front 1st phalanx
FP2	Front 2nd phalanx
FP3	Front 3rd phalanx
FRN	Frontal
HFC	Hoof cover
HP1	Hind 1st phalanx
HP2	Hind 2nd phalanx
HP3	Hind 3rd phalanx
HRN	Horn
HUM	Humerus
HYO	Hyoid
I	Incisor, upper or lower
INN	Innominate
INTC	Intermediate carpal (lunate)
JUG	Jugal
LAC	Lacrimal
LBN	Long bone
LC	Lower canine
LCH	Lower cheek tooth
LCR	Lower cheektooth row
LI0	Lower incisor
LI1	Lower 1st incisor
LI2	Lower 2nd incisor
LI3	Lower 3rd incisor
LIR	Lower incisor row
LM0	Lower molar
LM1	Lower 1st molar
LM12	Lower 1st or 2nd molar
LM2	Lower 2nd molar
LM23	Lower 2nd or 3rd molar
LM3	Lower 3rd molar
LMR	Lower molar row
LP0	Lower premolar
LP1	Lower 1st premolar
LP2	Lower 2nd premolar
LP3	Lower 3rd premolar
LP4	Lower 4th premolar
LPR	Lower premolar row
LTR	Lower tooth row
LUM	Lumbar
M	Molar, upper or lower
MAN	Mandible (no teeth)
MANT	Mandible with teeth
MAX	Maxilla (no teeth)
MAXT	Maxilla with teeth
MC0	Metacarpal
MC1	Metacarpal 1
MC2	Metacarpal 2
MC3	Metacarpal 3
MC4	Metacarpal 4
MC5	Metacarpal 5
MCM	Main metacarpal (3+4)
MET	Metapodial
MNB	Manubrium
MPA	Metapodial, accessory
MT0	Metatarsal
MT1	Metatarsal 1
MT2	Metatarsal 2
MT3	Metatarsal 3
MT4	Metatarsal 4
MT5	Metatarsal 5
MTM	Main metatarsal (3+4)
NAS	Nasal
NAV	Navicular
NID	Not identified
OCC	Occipital
P	Premolar, upper or lower
PAL	Palatine
PAR	Parietal

PAT	Patella
PHA	Phalanx
PH1	1st phalanx, front or hind
PH2	2nd phalanx, front or hind
PH3	3rd phalanx, front or hind
PIS	Pisiform (accessory carpal)
PMX	Premaxilla (no teeth)
PMXT	Premaxilla (w/teeth)
POD	Podial
PSL	Proximal lateral sesamoid
PSM	Proximal medial sesamoid
RAD	Radius
RDL	Radial carpal (scaphoid)
RIB	Rib
RUL	Radioulna
SAC	Sacral
SCL	Scapholunar
SCM	Sacrum (complete)
SCP	Scapula
SES	Sesamoid
SPH	Sphenoid
STE	Sternal segment
T1	Tarsal 1
T2	Tarsal 2
T23	Tarsal 2+3
TAL	Talus (astragalus)
TAR	Tarsal
TC4	Tarsal C+4 (naviculocuboid)
TEM	Temporal
THO	Thoracic
TIB	Tibia
TTH	Tooth fragment
UC	Upper canine
UCH	Upper cheek tooth
UCR	Upper cheektooth row
UI0	Upper incisor
UI1	Upper 1st incisor
UI2	Upper 2nd incisor
UI3	Upper 3rd incisor
UIR	Upper incisor row
ULN	Ulna
ULR	Ulnar carpal (cuneiform)
UM0	Upper molar
UM1	Upper 1st molar
UM12	Upper 1st or 2nd molar
UM2	Upper 2nd molar
UM23	Upper 2nd or 3rd molar
UM3	Upper 3rd molar
UMR	Upper molar row
UP0	Upper premolar
UP1	Upper 1st premolar
UP2	Upper 2nd premolar
UP3	Upper 3rd premolar
UP4	Upper 4th premolar
UPR	Upper premolar row
UTR	Upper tooth row
VAR	Various elements, assorted
VRT	Vertebra
ZYP	Zyphoid process

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The Sjovold Site

A River Crossing Campsite in the Northern Plains

Compared to the spectacular bison-kill sites for which the Plains region is justifiably famous, relatively little is known about the more ordinary aspects of ancient everyday life. Where did people make their homes? Why were particular sites chosen? Who might occupy a given camp and how long might they stay? What activities were carried out? The Sjovold site, situated on the west bank of the South Saskatchewan River in the far northern Plains, offers a long and detailed archaeological record with which to address these questions. People camped here more than twenty times over a period of 3,200 years, from 1850 B.C. to A.D. 1350. This book describes and interprets the findings from excavations of each encampment through this long sequence.

Locally, the Sjovold site offered shelter from the prevailing winds and access to the rich resources of a wooded creek valley. More generally, it seems to have been near the boundary between two vegetation zones: the grasslands and the aspen parklands. It is also near the Missouri Coteau, a long line of broken hills used historically as a war road. Perhaps more important, however, is its proximity to one of the few good river crossings in the region. This study specifies the criteria for defining and recognizing a river crossing campsite. It also explores many features of life in ancient times, inferring, along with the cultural and historical framework, societal dimensions such as group size and gender, trade and travel, as well as a wide variety of daily activities.

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